GAS JOURNAL

LIGHT ⁘ HEAT ⁘ POWER ⁘ BYE-PRODUCTS

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Editorial Notes.

"One in a Million."

SCARE-MONGERS and sensation hunters will find but little to assist them in the verdict which was returned at the Coroner's inquiry into the cause of death of the family of six at Heaton Norris, Stockport, last November, as the result of an escape of coal gas from a fractured main in the street in front of the house. The accident was a terrible one; and it was deplored by no one more deeply than by the members of the gas industry. We wish devoutly that the risks which are inseparable from life under any conditions could be still further reduced in so far as they are related to the activities of the gas industry—or, for the matter of that, of any other industry. That wish, however, is not engendered by a feeling that the risks attending a public gas supply are at present great. Far from it. When the magnitude of its operations is taken into account, these risks are already remarkably small. Subject to correction at the hands of those who may be better informed, we would venture the opinion that life in its most primitive form, as reflected by the liability of a bare-footed native to snake-bite in the jungle, represents a far greater risk than does the all-round best and cheapest means of lighting and heating which the highest stage of civilization has to offer.

There is not the slightest intention on our part of making light of anything that has happened, or is likely to happen, in connection with gas. A great responsibility rests upon the distribution side of the industry; but it is a responsibility which is realized to the full. Of late years no phase of gas engineering has received greater attention than the distribution side; and in spite of all the hair-raising alarums and excursions which may combine to confuse his senses, John Citizen may free himself of undue worry on account of his gas supply. In connection with accidents arising from gas, its universal use among the community should be taken into consideration; and we do hope that officials serving with gas undertakings who come in contact with consumers will keep this point well to the fore. It is proportion, or percentage, that is the most important element to study; but this is too often lost sight of—we do not even hint that it is ever kept in the background.

The chances of such a circumstance as that at Heaton Norris recurring the Lancashire County Coroner puts at "perhaps one in a million;" and, if anything, we should imagine that he has over-estimated the probability. But even if the chance be stated correctly, how re-assuring it is! What a convincing answer it affords to all the "dramatic" (oh, blessed word of the modern journalist!) stories that have appeared in the Press. The last-issued Board of Trade Returns relating to authorized gas undertakings showed that in 1927 there were nearly 9 million gas consumers; and this number has certainly since been appreciably increased. If it be assumed that there is an average of five persons only represented by the family, &c., of each consumer, one can arrive at something approaching the proportion of the population who are dependent upon gas; and the resultant figure proves that its use is practically universal. These consumers were at the date named served by nearly 46,000 miles of mains, and untold lengths of internal piping. There are here facts which provide an easy answer to such ungrounded fears as may have been implanted in the minds of nervous people. But even these figures do not really complete the tale, because, as was pointed out in the report on Gas Legislation of the Sub-Committee of the National Fuel and Power Committee (see p. 155 of last week's "JOURNAL"), there are nearly 600 non-statutory concerns, in addition to the 782 authorized gas undertakings dealt with in the Board of Trade Returns. These non-statutory undertakings are mostly quite small; but in the aggregate they must account for a considerable number of consumers and a good many miles of main.

So much for one aspect of this matter, to which there is also another side—duly emphasized by the Lancashire County Coroner in his verdict. The inquiry was a full one; and at the adjourned hearing—an account of which will be found on a later page of this issue of the "JOURNAL"—Mr. Newbigging gave some highly useful results of practical tests which he had made of breaking a 2-in. cast-iron main. He expressed the view that traffic vibration did not have anything to do with the fracture; but he did think that temperature might have been a contributory factor. The Borough Surveyor also said that the effect of traffic vibration was problematical. In his opinion, subsidence of the house footings, together with the earth (apparently due to percolation of surface water), caused a strain to be put upon the service pipe which was transmitted to the main, thus causing the fracture. The Coroner found that all the gas distributing material was sound; that the main and service pipes were well and truly laid; and that there was no external evidence to give warning of what was going on beneath the ground. This is a complete vindication of the Stockport Gas Department, who do just what all efficiently worked gas undertakings do—*i.e.*, adopt every means at disposal of securing the safety of the lives and property of the community. Gas engineering is in no way behind any other branch of the engineering profession.

Exaggeration must gradually whittle away the authority of those sections of the Press which indulge in it; but, in the meantime, there are still to be found many persons who are far more prone to accept what they read than to take the trouble of thinking-out things for themselves. In such cases those engaged in the gas industry can do useful work by pointing out the simple facts. The dangers of gas are infinitesimal when set beside the invaluable nature of its service to the community.

Fundamental Fuel Research.

THE laboratories of the Department of Chemical Technology at the Imperial College, Kensington, are unique in their equipment and in the problems which are investigated. The history of the Department, which is under the direction of Prof. W. A. Bone, D.Sc., Ph.D., F.R.S.—who combines the capacity of a true organizer with the temperament and capabilities of one of the foremost research workers on fuel—is a brief one, but it is one of unusually rapid progress. The year 1912 witnessed its birth; and in spite of the intervention of the war, the size of the laboratories has been doubled, such has been the growth of the work and activities. To-day, including the teaching staff of the Department, there are fifty people continually prosecuting scientific and technological studies—a fact which explains why it is that a scheme for further enlargement of the building has been approved, and will be carried out as soon as the means are available.

In conversation with Prof. Bone, one quickly gains an insight into the remarkable thoroughness and mental discipline which characterize the training of the research workers in the Department. Whether or not Prof. Bone's youthful incursions into the realms of philosophy led him to study Plato's Republic, it is certain that Plato would have regarded his system with the smile of approval, for the Department is undoubtedly an aristocracy of research intellect. How this becomes possible of achievement is told in later columns of the "JOURNAL" to-day. In the first place, only those of research abilities, and already in possession of the first tangible sign of scientific capacity—a university degree—are chosen. After two terms in the Department—spent as a hewer of wood and drawer of water—the would-be research student commences his training by being attached to a group of assistants prosecuting systematic lines of research which are planned in advance. After a year, he becomes disciplined both in the methods involved and in the accuracy demanded in research operations; and not until this stage is reached is he allowed either to commence work by himself or to become a group leader. In this way, as Prof. Bone explains, not only does the student learn to appreciate the value of co-operation, but a continuity of skilled workers is assured.

The Department's policy is based on a bedrock of fundamental research; and the work is uninterrupted by immediate plant problems and the like. In view of this, the equipment of the laboratories is unique. As our readers are aware, Prof. Bone and his co-workers have been engaged for many years in investigation of gaseous combustion and reactions at high pressures. Already a series of twelve papers embodying the results of these investigations have been presented to the Royal Society; and the columns of the "JOURNAL" bear witness to the care always exercised to keep our readers throughout in touch with the developments. The first section of the research, dealing with explosions at initial pressures up to 200 atmospheres, has been practically concluded. The next step is to investigate the effect of higher initial pressures—200 to 1000 atmospheres. For this purpose new apparatus (photographs of which are reproduced in this issue) has been installed, which will also enable systematic fundamental research work to be developed on catalytic reactions at high temperatures and pressures, and on such problems as coal hydrogenation. It is noteworthy that the equipment has been purchased out of grants from Imperial Chemical Industries, Ltd., and the Gas Light and Coke Company; and both the latter Company and Radiation, Ltd., have established Gas Research Fellowships in the Department. With regard to the chemistry of coal, research work is being carried out by four research assistants, chiefly with the aid of grants from the Fuel Research Board and from Sensible Heat Distillation, Ltd.

Since its inception, about 150 post-graduate students have passed through the Department; and most of them are now occupying responsible posts as fuel technologists, plant managers, chemical engineers, or research chemists in industrial concerns. Development has outstripped accommodation; but we have little doubt that the means will soon be available for enlargement of the laboratories, and thus extension of the Department's activities.

Be of Good Cheer.

IT is, perhaps, but natural that, in our moments of defeat, we should be more apt to describe the course of events as having been brought about rather by the good fortune of our adversary than by any shortcomings on our own part. Take, for example, the great number of instances in which gas is still preferred for street lighting. We see all manner of weird reasons put forward by way of excuse for this; but how seldom do "the other side" publish the real explanation, which is that for public lighting purposes gas at its best stands unrivalled? And it should be at its best in street installations; for public lighting contracts, while frequently unprofitable from the point of view of immediate financial return, cannot fail to be of substantial advertising value.

For this reason, if for no other, the contract for street lighting should be retained wherever possible. In many cases in which the gas supply has been in the hands of a company, while the electrical undertaking has been municipally owned, there has naturally been a disposition to feel that the ratepayers' best interests would be served by giving the work to the undertaking which was their own property; but this may quite easily prove to be a mistaken policy. Reflection suggests also other influencing factors which may be present. Eagerness to try something new seizes us all at times; and very often it is by giving way to this desire that we at long last learn the real value of that which we previously possessed. In places where both services are in the hands of the local authority, some such reason for fitting-up electric lamps as the existence of tramway standards may be brought forward; and, as a matter of fact, this, we learn, is what originally occurred at Stockton-on-Tees, though the Corporation owned facilities for installing electricity in the public thoroughfares for many years before it was actually introduced into the streets. Now the Gas Department have come along with a plea to be allowed to show what they can do with the aid of gas lamps of the most up-to-date type. Permission being granted, two low-pressure, high-power lamps, fitted with parabolic reflectors, have been put up as samples—with, we gather, excellent results. So the matter stands at present.

And the moral? The moral is that there is always a chance of the superior qualities of gas—including the highly-important one (from a street lighting point of view especially) of reliability—being recognized. The handicap in some cases—we are not for a moment suggesting that it is so in Stockton—may be heavy; but the battle is always worth fighting, with so many effective arguments as the gas industry has at its command. Never allow the lighting to be lost sight of, either in the streets or in the homes of gas consumers—in other words, in practically every house in the area of supply. Because of all that it represents, we would rather see lighting among the first objectives of the gas engineer than the last.

Farewell the Skid?

SLIPPERINESS of the modern road is a topic of current discussion. The recent advent of a horse on the small portion of the roadway reserved for the pedestrian has added a fillip to this interest, but the main cause lies in the continuous number of fatalities resulting from the skidding of motor vehicles. Much of this skidding has occurred on roads with a black, and, therefore—according to the public's idea—tarred, surface. Of course, one can well understand that the general public do not differentiate between bitumen and tar; but this does not alter the fact that tar has to shoulder the responsibility of accidents of which it is entirely innocent. Road tar has grown out of an inglorious infancy, but it is often blamed for faults which are those of bituminous materials of alien origin. Hence the urgent necessity of explaining that tar is not bitumen; hence also the virtue of the paper which Mr. W. J. A. Butterfield read recently before a meeting of Municipal and County Surveyors at Leeds, an important extract of which is published in our columns to-day.

Twenty-five years ago, road surfacing was not a science;

it was a haphazard affair. Because of its cheapness, wholly unsatisfactory tar was gladly accepted by surveyors, and applied with optimism to the surface of roads. Small wonder that the results were often far from good. It was not until 1907 that—thanks to the enterprise of certain tar distillers and highway authorities—proper consideration was given to the marketing of a suitable product. Subsequently, Road Board and Road Department Specifications were drawn up, and a good standard road tar became assured. This step necessarily improved matters; but the fact remained that, though supplied with excellent material, those responsible for the construction of roads paid insufficient attention to its application. And it is one of the functions of the newly-formed British Road Tar Association to explain that British tar, correctly applied, forms a durable road surface safe alike to motorists and horses.

Ample proof that the latter statement is valid is to be found in the paper to which we have referred. Mr. Butterfield makes it clear that, when tar (as distinct from other forms of bitumen) is employed, slipperiness arises only when the gritting or "blinding" of the coating is at fault. There is still a tendency to blind a surface dressing of tar by fine dust. True, this prevents surface stickiness, but it produces a smooth surface which is polished by the action of traffic, and, even when dry, becomes slippery to shoes and hoofs. Any surplus dust unabsorbed by the tar acts as a polishing powder. The remedy for this is simple. It consists merely in careful selection of the gritting material, and the screening of this material (which ought to be in granules of $\frac{1}{4}$ in. to $\frac{3}{4}$ in., or even larger) free from dust. Mr. Butterfield points out that such material works into, and is retained by, a surface coating of tar, and eliminates slipperiness. The British Road Tar Association have investigated numerous complaints as to the slippery nature of so-called "tarred roads," and without exception it has been found that such roads were not tarred roads.

There remains to be shattered the misconception that properly prepared tar is in itself injurious to fish life. Here again the outcome of bad beginnings has to be faced, for in the early days crude tar was often employed. As Mr. Butterfield observes, it was considered by some councils that an additional farthing a gallon for tar to put on roads would be a shameful waste of money. We call particular attention to his statement that the risk of damage to fish through rain washings from modern road surfaces lies primarily in the fine dust which motor traffic produces, and that there appears to be no sensible difference in the toxicity of the road surface silt whether the surface consists of modern road tar, asphaltic bitumen, or concrete.

Altogether, tar has an excellent case, particularly in view of the new specifications (the outstanding feature of which is the higher consistency of viscosity) brought forward by the British Road Tar Association; and there can be no doubt that its greater employment for road making and surfacing will render the roads of this country far safer, and will make it unnecessary for those who hunt to invade the narrow preserves of the humble pedestrian. "British Tar for British Roads" is no idle slogan.

Our Highways.

"One sometimes reads in books about people who feel that they are living over a volcano. The expression, of course, is used in a figurative sense. But to the inhabitants of a modern great town it begins to look like the literal truth. We, Londoners and others, walk over hidden dangers. Beneath our feet lie potent forces which may erupt in flame, flood, or deadly vapour." With these sentences, Sir Sidney Low opens an article in the "Daily Mirror," in which he asks what is wrong with our public highways, and enters a plea for better road-planning. We have, of course, the end in view which the writer of the article would wish—namely, the rendering of a necessary service in the best and safest manner possible—and the industry is always prepared to consider practical suggestions of improvement. Sir Sidney Low sketches the growth of the traffic problem, and announces that the solution lies in the reconstruction of most of the streets and roads—particularly the main thoroughfares in towns. They should be hard and solid, on secure foundations; and pipes and wires should not be buried beneath them, but should be laid in tunnels or aqueducts at the sides. The proposal is not a new one; and Sir Sidney realizes that "the cost will be so enormous that we shall have to wait long years for this traffic millennium." In the meantime, he would insist upon new roads and streets being scientifically planned and constructed, and upon all heavy vehicles being provided with pneumatic tyres.

Fifty Years' Gas Progress at Melbourne.

On later pages of this issue is published an illustrated article on the growth of the Metropolitan Gas Company of Melbourne during the past fifty years. The Company's history is one of rapid progress, as will be understood when it is mentioned that, whereas in 1878 the gas sold amounted to less than 500 million c.ft., the corresponding figure for 1927 was over 4136 millions. The present manufacturing plant has a capacity of 19½ million c.ft. a day, and the holders at the works and the out-stations have a storage capacity of 23½ million c.ft. The actual area over which the Company may operate is approximately 125 square miles; and up to the end of 1927, the total length of mains was about 1292 miles. As long ago as 1902 the Company realized the value of cookery demonstrations; and weekly lectures are a regular feature of their activities. Another fact is that fifteen years ago lady demonstrators were engaged to call on new consumers, instructing them in the most economical methods of using gas cookers—a sales system which has yielded good results and is still in vogue. Our readers will be interested in the census of the equipment of hotel kitchens in Melbourne which was taken in 1927. This showed that, of 467 establishments, 456, or 97·6 p.ct., were using gas either exclusively or in conjunction with other fuels.

Assisting the Air Service.

An indication of the trend of events is an announcement made by our American contemporary the "Gas Age-Record" that the Daniel Guggenheim Fund for the Promotion of Aeronautics is asking for the co-operation of the country's major industries in a nation-wide movement for the identification of towns and cities by roof-markings, as it is felt that such identification is essential if the aeroplane is to be of practical value, and an adequate system of commercial air transportation developed. As a basis for this work, the fund, with the co-operation of the Postmaster-General and the Government Departments of War, Navy, and Commerce, have asked some 8000 postmasters in towns with a population between 1000 and 50,000 to work towards the end that their communities be properly identified by roof markings. For such marking the fund organizers recommend the use of block letters in chrome yellow, with a black background on a roof where the visibility is not reduced by smoke; and that the marking should include the name of the city or town, together with an arrow pointing due north with the letter "N" over it, and another indicating the local airport, if there is one.

Marking the Gasholder.

For this purpose, the top of a gasholder is ideal; and an example was quoted in the "JOURNAL" quite recently—the new 20 million c.ft. waterless holder at Chicago. Across the top of this 283-ft. diameter holder a broad arrow points to the Chicago airport, in 30-ft. letters, in chrome yellow on a black background. The arrow is flood-lighted, making for easy visibility from the air. While admitting that not many gas companies will be in a position to do such an unusual job, as in the case of the Chicago holder the aviation aid and collateral details added $65,000 to the cost, the "Gas Age-Record" says: "Such co-operation, however, creates excellent public relations, as well as helping along the development of aircraft. These markings on the gasholder should protect it from being hit by an aeroplane flying at night, with perhaps most unpleasant consequences all around—not at all an impossibility when the low visibility and relatively great height of the ordinary gasholder are considered."

PERSONAL.

Dr. E. F. ARMSTRONG, F.R.S., D.Sc., F.I.C., has been appointed a Director of the South Metropolitan Gas Company in place of Mr. Edward Honoratus Lloyd, K.C., who recently retired.

Mr. P. S. HOYTE, M.I.Mech.E., who recently retired from the position of Chief Engineer and Manager to the Plymouth and Stonehouse Gas Light and Coke Company, and is now acting as their Consulting Engineer, has been elected a Member of the Institution of Civil Engineers.

The marriage took place, on Jan. 21, at Eastbourne, of Mr. HARRY TOWNSEND, late Managing Director of the Wakefield Gaslight Company, and Miss Evelyn M. Gray, only daughter of the late Mr. A. G. Gray, solicitor.

On Monday, Jan. 14, a presentation was made to Mr. R. J. H. SAYERS, the London Manager of West's Gas Improvement Company, Ltd., to commemorate his fiftieth year of service with the Company. Mr. Fred. J. West, Chairman of the Company, in making the presentation on behalf of the principal officials assembled at a dinner at which Mr. Sayers was the honoured guest, referred to his early association with Mr. John West, the founder of the Company, in the design and development of stoking machinery, regenerative horizontal and inclined retort settings, and, later, the continuous vertical retort.

Mr. H. D. MADDEN, Engineer and Manager of the Cardiff Gas Light and Coke Company, has been elected Chairman of the South Wales Branch of the Institution of Mechanical Engineers; and Mr. W. H. JOHNS, Engineer and Manager of the Swansea Gas Light Company, has been elected to the Committee.

The coming-of-age of Mr. MAURICE THORNTON, only son of Mr. and Mrs. H. M. Thornton, of Purley, was celebrated by a reception and dance at the Hyde Park Hotel. Mr. Thornton has started business in the gas stove industry, and we hope he will have a successful and useful career.

In last week's "JOURNAL," p. 148, in announcing the appointment of Mr. G. J. GREENFIELD as Works Manager of the Thorncliffe Coal Distillation, Ltd., we stated that he would succeed Mr. Robert Ray as this year's President of the Coke Oven Managers' Association. This is incorrect, as the Presidential Chair was taken by Mr. A. H. MIDDLETON, General Manager of the Coke Oven and Bye-Product Works of the Consett Iron Company, Ltd., and formerly Vice-President, upon its being vacated by Mr. ROBERT RAY, who resigned on taking up his new appointment with the Woodall-Duckham Companies. This step was rendered necessary under the constitution of the Association, which allows no member to hold office unless actively engaged in the management and operation of a coking plant.

OBITUARY.

The death occurred, at 24, Princes Square, Glasgow (the residence of her son, Mr. J. W. McLusky, who is Engineer and Manager to the Glasgow Corporation Gas Department), on Jan. 15, of Mrs. MARY M'LACHLAN MCLUSKY, who, behind the scenes, was for more than half-a-century a great champion of the gas industry. She was well known to many gas engineers on both sides of the border, who will miss her friendly wisdom. Mrs. McLusky had three sons in the industry—namely, Mr. W. B. McLusky (Halifax); Mr. S. G. McLusky (Keighley, Works Superintendent under Mr. Arthur Bromley); Mr. J. W. McLusky; and three grandsons—namely, Mr. James McLusky (Calverley); Mr. James McLusky (Keighley, Technical Assistant); and Mr. W. B. McLusky, Jun. (Parkinson Stove Company, Ltd.).

The death has occurred at his residence, "Glandyr," Crickhowell, of Mr. JAMES ISAAC, a Director of the Crickhowell Gas and Coke Company, at the age of 53 years. Mr. Isaac, who has been in poor health for some time past, was a member of the Breconshire County Council.

FORTHCOMING ENGAGEMENTS.

[*Secretaries of Gas and Kindred Organizations are asked to assist in making this diary of events as complete and useful as possible by sending the earliest intimation of all meetings.*]

Jan. 25.—LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION.—Meeting at the Westminster Technical Institute. Paper by Mr. C. A. Masterman, on "The Thermal Insulation of Gas Consuming Apparatus."

Jan. 26.—SCOTTISH JUNIOR GAS ASSOCIATION (WESTERN DISTRICT).—Visit to Messrs. Peebles & Co., Ltd., Tay Works, Bonnington, Edinburgh.

Jan. 28.—ROYAL SOCIETY OF ARTS.—Meeting in John Street, Adelphi, W.C. 2, at 8 p.m. Second Cantor Lecture by Dr. C. H. Lander on "The Treatment of Coal."

Feb. 4.—ROYAL SOCIETY OF ARTS.—Meeting in John Street, Adelphi, W.C. 2, at 8 p.m. Third Cantor Lecture by Dr. C. H. Lander on "The Treatment of Coal."

Feb. 12.—NATIONAL GAS COUNCIL.—Meeting of the Central Executive Board.

Feb. 12.—FEDERATION OF GAS EMPLOYERS.—Meeting of Central Committee.

INSTITUTION OF GAS ENGINEERS.

Feb. 12.—Gas Education Executive Committee, 4 p.m.

Feb. 13.—Executive Committee, 10.30 a.m.; Finance Committee, 11.30 a.m.; Benevolent Fund Committee, 12 noon; Berlin Visit Committee, 2 p.m.; Council Meeting, 2.30 p.m.

Lectures on the Chemistry of Coal.

Knowledge of the chemistry of coal and its application to the problems of carbonization is of fundamental importance to the development of the gas and allied industries; and it is therefore interesting to learn that the University of London has recognized the need for higher education in this respect by accepting "The Chemistry of Coal Carbonization" as a subject for the M.Sc. Degree examination in the case of certain students. The Sir John Cass Technical Institute is accordingly arranging, for those engaged in industry, a course of evening lectures to cover the syllabus of this examination. As announced in later columns, the inaugural lecture will be given on Monday, Jan. 28, by Dr. F. S. Sinnatt, M.B.E., Assistant Director of Fuel Research of the Department of Scientific and Industrial Research; and this will be followed by twelve lectures by Mr. H. D. Greenwood, M.Sc., A.I.C., of the South Metropolitan Gas Company, commencing on Feb. 4.

ON THE ELECTRICAL SIDE.

The Fifth Scheme.

There have now been published full details of the Electricity Commission's fifth scheme, which covers the larger part of Yorkshire, parts of Lincoln and Rutland, and parts of Nottingham and Derby. It is stated that there is a sum of £2,907,156 to be incurred before 1935-36. Extensions of generating stations will involve an outlay of £1,709,594, making a total of £4,616,750. Seventy-three undertakings are operating in the zone, chief among them being the Yorkshire Power Company, with its subsidiary, the Electrical Distribution of Yorkshire, and the Corporations of Sheffield, Rotherham, Leeds, Bradford, Hull, Halifax, Huddersfield, Wakefield, York, and Harrogate. The population of the area is 4,667,000; and the consumption of electricity during the last year recorded—namely, 1927-28—was 855,000,000 units. It is calculated that by 1941 the consumption should be equivalent to about 580 units per head of the population. The area, prior to survey by the Electricity Commission, has been very fully organized; and all that the Central Board will have to do is to link-up existing generating stations, establish connection between the Yorkshire Power Company's system and those of the various municipalities, and bring the zone into connection with the South-East England, North-West England, and Central England schemes. It will also be necessary to make arrangements for a main transmission line running near the coast into the area supplied by the Newcastle Electric Supply Company. The only area of any importance remaining to be surveyed is the highly-organized North-East Coast, supplied almost entirely by the Newcastle Electric Supply Company.

Under or Over?

What with one section of the community (we believe it to be small) suggesting that gas mains should not be put underground, and another section (apparently a far larger one) agitating against the running of electric cables overhead, the "man in the street"—almost as convenient a figure to bring upon the scene as the famous "hypothetical tenant" in rating cases—must be a little puzzled. He can see, of course—it would be strange indeed if he did not—that (to employ the description of one correspondent of "The Times") "a huge array of pylons from 30 ft. to 40 ft. high to carry the great cables" must be as beauty-destroying as a modern army in war; but the line of reasoning which would result in the distinterment of all the gas mains, must be more difficult for him to follow. He realizes without any brain-fag that electric cables would be more suitably placed underground than up in the air; and he might reasonably conclude that the same remark would apply to gas mains, though it is true that contact with an overhead gas main could hardly be fraught with the terrible consequences which have recently resulted in more than one instance from overhead electric cables.

Not only the "man in the street," but the "child in the street" also is aware that the danger threatened by any gas main or electric cable under the street is as nothing compared

with the risks which seem inseparable from the motor traffic above—or, in other words, that the subsoil contains not a tithe of the menace that is held by the surface. Both man and child, if they go about with their eyes open, must get knowledge of motor accidents which reasonable care would have avoided; while, on the other hand, they know, or ought to know, that gas mains are laid by skilled men under efficient supervision. Therefore it must sometimes be wondered why, while the ever-mounting toll of the streets is so seldom the subject even of a protest, an accident arising out of leakage from a gas main receives unlimited publicity. Perhaps the man in the street puts it all down to faulty perspective; and in his kindness of heart, he may feel sorry for those who lack a sense of proportion.

A Handicap of Electricity.

While gas is being made the subject of so much vituperation, there is, in one quarter at any rate, a feeling that even electrical affairs are capable of some small improvement. Mr. Harry Moss has been appealing, through the columns of the "Electrician," to the Electricity Commissioners in the matter of shoddy workmanship. His argument—and a very reasonable one, too—is that the ever-increasing uses to which electricity is being put demand that only safe, reliable work be carried out, by "authorized" persons or firms. At present, he believes, the electrical contracting trade is more abused than any other. It has been an open door for any to enter by; and its ranks have been swollen beyond all reason with thousands of undesirables. In support of his claim that nothing short of Government action can stop the dangerous practices that are now being carried out, Mr. Moss says: "It is a trade that can be dabbled in by anyone who knows a switch from a piece of wire, and cares to style himself an 'electrical engineer' or 'electrical contractor.' Isn't it a farce that any incompetent, unskilled person, who cares to have a few cards printed and buy a few shillingsworth of wire and electrical accessories, should be allowed to style himself an electrical engineer? Some of these men are neither electricians with a knowledge of the science of electricity, nor engineers with the knowledge of engineering as it is known to-day; and yet they are allowed to proclaim themselves to the public at large, by means of printed matter, posters and sign-boards, newspaper advertisements, &c., as electrical engineers. These men are gulling and robbing the public daily. They are the class of men who are laying veritable death-traps in the homes and shops of this country, by the way in which they are installing wires and fittings that are called electrical installations, which, in hundreds of cases, are a positive danger to the community. These men have no idea of rules and regulations, of earthing, carrying capacities, loading, &c.; yet they keep doing the jobs, and these are connected-up to supply systems, either public or private. Dangerous extensions are also added to otherwise good installations."

"Is it," asks Mr. Moss, "beyond the power of the Electricity Commissioners to make a strong recommendation to His Majesty's Government to safeguard the electrical contracting industry, and confine electrical wiring and installation work to approved and competent firms, and thus protect the public from the dangers that exist through the shoddy work that is regularly being connected to the supply mains?" Evidently large numbers of consumers of electricity are running risks of which they are blissfully ignorant. An interlude in "gas baiting" might be utilized by the Press in suitably warning them.

GAS STOCK AND SHARE MARKET.

[For Stock and Share List, see later pages.]

There was a comparatively cheerful atmosphere on the Stock Exchange last week; but with less initiative from New York, upon which markets depend so much nowadays, business was not so active, and, at the end of the week, the preliminary carry-over arrangements accentuated the restriction.

There was no lack of business in the Gas Market, however, the transactions being much above the normal for the time of the year. Imperial Continental was again the most prominent feature, and a 30 points rise in the quotation was recorded. The yield on the present average quotation, calculated on the last dividend of 10 p.ct., is now just under £3 11s. 6d. p.ct. As we have already stated, there appears to be no justification for the exceptional rise, and it is not expected that the price will hold. It is rumoured that the purchases are in the main being made through a powerful financial firm, but the extent of the operations is not known. Both the Continental Union ordinary and preference stocks moved up again, and the Gas Light 4 p.ct. ordinary recovered after the recent set-back. The rise of 9d., to 19s.-19s. 6d., appears to indicate a confidence in the results of the past year, the accounts for which it is anticipated will be published before our next report. There were no adverse movements, and stocks were in general demand.

The following transactions were recorded during the week:

On Monday, Bournemouth 6 p.ct. pref. 11$\frac{3}{16}$, 11$\frac{3}{8}$, Bristol 5 p.ct. 93, Cape Town and District 8$\frac{1}{2}$, Commercial 99$\frac{1}{2}$, Continental Union 120, 120$\frac{1}{2}$, 121, 121$\frac{1}{2}$, 121$\frac{3}{4}$, Croydon sliding-scale 112, European 11$\frac{1}{8}$, 11$\frac{3}{8}$, 11$\frac{1}{2}$, 11$\frac{9}{16}$, Gas Light and Coke 18s. 7$\frac{1}{2}$d., 18s. 9d., 18s. 10$\frac{1}{2}$d., 18s. 11$\frac{1}{4}$d., 19s., 19s. 1$\frac{1}{2}$d., 3$\frac{1}{2}$ p.ct. 64$\frac{3}{4}$, 65$\frac{1}{2}$, 4 p.ct. pref. 80$\frac{1}{2}$, 3 p.ct. deb. 60$\frac{1}{2}$, 61, 5 p.ct. deb. 101, Imperial Continental 245, 246, 247, 248, 248$\frac{1}{2}$, 250, 250$\frac{1}{2}$, 251, 252, 253, Montevideo 96$\frac{1}{2}$, Portsmouth 5 p.ct. max. 81, Primitiva 26s. 3d., 26s. 6d., 26s. 9d., 26s. 10$\frac{1}{2}$d., 27s., South Metropolitan 3 p.ct. deb. 61, Southampton 5 p.ct. 78$\frac{1}{2}$. Supplementary prices, Chester United 90, Eastbourne 3$\frac{1}{2}$ p.ct. "B" 106$\frac{1}{2}$, Gas Light and Coke 5 p.ct. deb. 1952-57 101.

On Tuesday, Alliance and Dublin 100, Bombay 22s., Continental Union 119$\frac{1}{2}$, 120, 120$\frac{1}{2}$, 121, 121$\frac{1}{2}$, Croydon sliding-scale 113, European 11$\frac{9}{32}$, 11$\frac{5}{16}$, 11$\frac{3}{8}$, £11 8s., 11$\frac{5}{8}$, Gas Light and Coke 18s. 10$\frac{1}{2}$d., 19s., 19s. 1$\frac{1}{2}$d., 19s. 3d., 3$\frac{1}{2}$ p.ct. 64$\frac{3}{4}$, 4 p.ct. pref. 79$\frac{1}{2}$, 80$\frac{1}{2}$, 3 p.ct. deb. 60, 60$\frac{1}{2}$, 5 p.ct. deb. 101, Imperial Continental 245, 246, 247, 248, 249, 249$\frac{1}{2}$, 250, 250$\frac{1}{2}$, 251, 251$\frac{1}{2}$, Liverpool 7 p.ct. pref. 102, 102$\frac{3}{4}$, Primitiva 26s. 9d., 27s., 27s. 1$\frac{1}{2}$d., 27s. 3d., 27s. 6d., South Metropolitan 108, 6$\frac{1}{2}$ p.ct. deb. 102, South Suburban 5 p.ct. deb. 99, Southampton 5 p.ct. 79. Supplementary prices, Chester United 91, Gas Light and Coke 5 p.ct. deb. 1952-57 101, Liverpool 5 p.ct. 90$\frac{3}{4}$, 91$\frac{3}{8}$, Tottenham 5 p.ct. pref. 92$\frac{1}{2}$.

On Wednesday, Bournemouth 5 p.ct. 13, "B" 12$\frac{3}{4}$, 13, British 117, Continental Union 121, 121$\frac{1}{2}$, 122$\frac{1}{2}$, European 11$\frac{1}{8}$, 11$\frac{5}{16}$, 11$\frac{3}{8}$, 11$\frac{7}{16}$, 11$\frac{1}{2}$, Gas Light and Coke 19s., 19s. 1$\frac{1}{2}$d., 19s. 3d., 19s. 4$\frac{1}{2}$d., 4 p.ct. pref. 79$\frac{1}{4}$, 79$\frac{1}{2}$, 80$\frac{1}{2}$, 3 p.ct. deb. 60, 5 p.ct. deb. 100, Imperial Continental 249$\frac{1}{4}$, 249$\frac{1}{2}$ 249$\frac{3}{4}$, 250, 250$\frac{1}{4}$, 251, 251$\frac{1}{2}$, 251$\frac{3}{4}$, 252, 252$\frac{1}{4}$, 252$\frac{1}{2}$, 253, 254, 254$\frac{1}{2}$, 255, 255$\frac{3}{8}$, 256, 257, 257$\frac{1}{2}$, 258, 259, 260, 261, 262, Metropolitan (of Melbourne) 5$\frac{1}{2}$ p.ct. deb. 101$\frac{3}{4}$, Montevideo 96$\frac{1}{2}$, Newcastle 3$\frac{1}{2}$ p.ct. 16s. 3d., 17s. 1$\frac{1}{2}$d., Primitiva 26s. 10$\frac{1}{2}$d., 27s., 27s. 1$\frac{1}{2}$d., 27s. 4$\frac{1}{2}$d., South Metropolitan 107$\frac{1}{4}$, 107$\frac{1}{2}$, 6$\frac{1}{2}$ p.ct. deb. 102, Southampton 5 p.ct. max. 79, Uxbridge Maidenhead 5 p.ct. 96. Supplementary prices, Barnet District 4 p.ct. deb. 77$\frac{1}{2}$, Gas Light and Coke 5 p.ct. deb. 1952-57 101, Hastings and St. Leonards 3$\frac{1}{2}$ p.ct. deb. 63, 63$\frac{1}{2}$, Liverpool 5 p.ct. 90$\frac{3}{4}$.

On Thursday, Alliance and Dublin 99$\frac{1}{2}$, 100$\frac{1}{2}$, Brighton and Hove 5 p.ct. 103$\frac{1}{4}$, 103$\frac{3}{4}$, British 117, 117$\frac{3}{4}$, 4 p.ct. deb. 76, Cape Town 9, Commercial 99$\frac{7}{8}$, 3 p.ct. deb. 58$\frac{3}{4}$, Continental Union 123, 123$\frac{1}{2}$, 124, 124$\frac{1}{2}$, 125, 126, 127, 127$\frac{1}{2}$, 128, European 11$\frac{1}{8}$, 11$\frac{1}{4}$, 11$\frac{3}{8}$, 11$\frac{7}{16}$, 11$\frac{1}{2}$, 11$\frac{5}{8}$, Gas Light and Coke 19s., 19s. 1$\frac{1}{2}$d., 19s. 3d., 19s. 4$\frac{1}{2}$d., 3$\frac{1}{2}$ p.ct. 65$\frac{1}{2}$, 4 p.ct. pref. 79$\frac{1}{2}$, 79$\frac{3}{4}$, 3 p.ct. deb. 60$\frac{1}{2}$, 5 p.ct. deb. 101, Hornsey 3$\frac{1}{2}$ p.ct. 90, Imperial Continental 260, 264, 265, 270, 271, 272, 272$\frac{1}{2}$, 273, 273$\frac{1}{2}$, 274, 275, 276, 277, 278, 280, 281, 282, 283, 283$\frac{1}{2}$, 284, 285, Montevideo 96$\frac{3}{4}$, 97, Primitiva 26s. 9d., 26s. 10$\frac{1}{2}$d., 27s. 1$\frac{1}{2}$d., 4 p.ct. deb. (1911) 79$\frac{1}{2}$, South Metropolitan 106$\frac{1}{2}$, 107$\frac{1}{2}$, 3 p.ct. deb. 61, Uxbridge Maidenhead 5 p.ct. 97. Supplementary prices, Gas Light and Coke 5 p.ct. deb. 1952-57 101, Hornsey new 5 p.ct. pref. 88, Liverpool 5 p.ct. deb. 90$\frac{3}{4}$, Metropolitan (of Melbourne) 9$\frac{5}{8}$, North Middlesex 5 p.ct. deb. 98$\frac{1}{2}$.

On Friday, Commercial 100$\frac{3}{4}$, Continental Union 125, 129$\frac{1}{2}$, 130, 131$\frac{1}{2}$, 132, 133, 7 p.ct. pref. 125, Croydon max. div. 86, 87, European 11$\frac{1}{8}$, 11$\frac{1}{2}$, 11$\frac{5}{8}$, Gas Light and Coke 19s., 19s. 1$\frac{1}{2}$d., 19s. 3d., 19s. 3$\frac{3}{4}$d., 19s. 4$\frac{1}{2}$d., 3$\frac{1}{2}$ p.ct. max. 64$\frac{1}{2}$, 64$\frac{3}{4}$, 65, 4 p.ct. pref. 79$\frac{1}{2}$, 80$\frac{1}{4}$, 3 p.ct. deb. 60, 60$\frac{1}{2}$, 5 p.ct. deb. 101, Imperial Continental 272, 273, 274, 275, 275$\frac{1}{2}$, 276, 277, 278, 279, 280, 280$\frac{1}{2}$, 281, 282, 283, 284, Metropolitan (of Melbourne) 5$\frac{1}{2}$ p.ct. deb. 101$\frac{1}{2}$, Newcastle 3$\frac{1}{2}$ p.ct. 17s. 6d., Primitiva 26s. 6d., 26s. 7$\frac{1}{2}$d., 26s. 9d., 27s., 27s. 1$\frac{1}{2}$d., 27s. 3d., South Metropolitan 107$\frac{1}{2}$, 108. Supplementary prices, Gas Light and Coke 5 p.ct. deb. 1952-57 101, Southgate and District 7$\frac{1}{2}$ p.ct. deb. 101$\frac{5}{8}$.

At the week-end easier conditions prevailed in Lombard Street, and credit was in plentiful supply, but money was not perhaps so freely offered as usual. Old day-to-day loans were renewed at 3$\frac{1}{4}$ p.ct.; but it was reported that money for a month was bid for at 4$\frac{1}{4}$ p.ct. Treasury Bills were allotted at £4 5s. 2·06d. p.ct., being 2·20d. p.ct. below the previous week's rate. Discount rates were perhaps a little easier.

In the Foreign Exchange Market, Sterling on New York rallied slightly to 4.85$\frac{7}{16}$. Among Continental currencies, French francs depreciated to 124.07$\frac{1}{2}$; Belgas to 34.91; Dutch florins to 12.09$\frac{3}{4}$; and Spanish pesetas to 29.71. German reichmarks, however, were dearer at 20.39$\frac{3}{4}$; and Italian lire were unchanged at 92.68.

Silver, with a small amount of Indian buying, improved slightly to 26$\frac{7}{8}$ per oz.; while Gold, with none offering, remained at the nominal price of 84s. 11$\frac{1}{2}$d. per oz.

The Bank Rate is 4$\frac{1}{2}$ p.ct., to which it was reduced from 5 p.ct. on April 21, 1927. The Banks' deposit rate is 2$\frac{1}{2}$ p.ct., and the deposit rates of the discount houses are 2$\frac{1}{2}$ p.ct. at call and 2$\frac{3}{4}$ p.ct. at notice.

GAS BILLS FOR 1929.

(*Continued from p.* 161.)

SOUTHPORT.

In a General Purposes Bill of the Southport Corporation, there is a section dealing with gas matters. It is mentioned in the preamble that estimates have been prepared by the Corporation for the construction of a gasholder at a cost of £60,000. Thirty years from date of borrowing is asked for repayment of this.

The clause to enable the Corporation to purchase, sell, let for hire, &c., apparatus, pipes, and other gas fittings, has added to it the words "and may also purchase, sell, let for hire, repair, and remove stoves for consuming coke or smokeless fuel, and may provide all materials and do all work necessary or proper in that behalf, and with respect thereto may demand and take such remuneration or rents and charges, and make such terms and conditions, as may be agreed upon." Further powers are taken to enter premises in order to inspect fittings and works for the supply of gas, and for the purpose of ascertaining the quantity of gas consumed. It is stipulated that the powers conferred upon the Corporation by section 21 of the Gas-Works Clauses Act, 1871, shall extend to premises in which there is any service pipe connected with the gas mains of the Corporation, except where the occupier of the premises shall have applied in writing to the Corporation for the disconnection of the service pipe from the mains of the Corporation. The power to enter premises to remove pipes, meters, and fittings is also extended so as to include all cases in which any person entering into occupation of any premises previously supplied with gas by the Corporation shall not require to take such supply or to hire fittings, &c., belonging to the Corporation.

There is a clause giving authority to compel repairs in case of danger, and another having reference to the laying of pipes for ancillary gas purposes.

USE OF GAS GEYSERS.

The following clause has relation to the use of gas geysers:

> No gas geyser or other similar hot-water apparatus heated by gas shall be used in any premises unless it is supplied with a proper ventilating pipe or shaft open to the external air for the adequate dispersal of fumes or unconsumed gas so as to avoid danger or injury to health.
>
> The surveyor or sanitary inspector or other officer authorized in that behalf may at all reasonable times enter any premises where he has reason to believe that any such geyser or hot-water apparatus is retained, fitted, or used in order to inspect the same; and if he be satisfied that such geyser or hot-water apparatus does not comply with the provisions of this section, he may order the occupier of the premises to disconnect the same or cause the same to be disconnected from the gas supply. And if such disconnection be not effected within twenty-four hours, then the surveyor or sanitary inspector may disconnect or cause the same to be disconnected.
>
> Any person offending against the provisions of this section shall be liable to a penalty not exceeding £5.

It is asked that the Weights and Measures Act, 1889, shall apply to the sale of coke, and that there shall be penalties for fraudulent sales.

[*Parliamentary Agents: Messrs. Sharpe, Pritchard, & Co.*]

SOUTH SUBURBAN GAS COMPANY.

ABSORPTION OF THE NORTHFLEET AND GREENHITHE GAS COMPANY, LTD.

The Northfleet and Greenhithe Gas Company, Ltd., have agreed with the South Suburban Gas Company for the transfer of their undertaking to that Company; and the main objects of this Bill are to provide for the carrying into effect of that agreement, and to extend the limits of supply of the South Suburban Company. The terms of the agreement, which is dated Nov. 14, 1928, are set forth in a schedule to the Bill.

The Northfleet Company are authorized by the Northfleet and Greenhithe Gas Order, 1881, to supply gas within parts of the parish of Northfleet and the parish of Swanscombe. The issued capital consists of £27,235 of ordinary stock and £2765 of preference stock. There are also debentures to the aggregate amount of £7500. The Company are to sell their undertaking to the South Suburban Gas Company at the price of £44,865, freed of all incumbrances and liabilities other than debenture debt. The stores of the Company at the day of transfer shall include not less than 300 tons of Durham unscreened coal; and in the event of the amount being more or less, an allowance at the rate of 21s. 3d. per ton shall be added to, or deducted from, the purchase price. The South Suburban Company are to have an option (to be declared within one month of the Bill receiving the Royal Assent) to take over the carburetted water gas plant of the Northfleet Company at the price of £950. In the event of this option not being exercised, the plant will remain the property of the Northfleet Company, who shall forthwith remove it. The purchase of the undertaking is to be completed on June 30, 1929, or at the expiration of one calendar month from the date on which the Act confirming the agreement receives the Royal Assent, whichever date shall be the later. On the day of transfer, the South Suburban Company shall pay, as compensation for loss of office, to the Directors of the Northfleet Company the sum of £1925. If, for any reason, the purchase is not completed on June 30, 1929, the South Suburban Company shall (unless the delay is caused through the default of the Northfleet Company) pay interest at the rate of 5 p.ct. on the purchase price Every person who on the day of transfer is in the employment of the Northfleet Company shall be taken over by the South Suburban Company on the same basis as to position and emoluments as that on which he was on the day of transfer. In the event of the South Suburban Company dispensing within three years (otherwise than on account of misconduct) with the services of Mr. J. A. Brentnall, the Engineer of the Northfleet Company, or Mr. G. R. Ripley, the Secretary, or in the event of the salary or emoluments received being reduced, the South Suburban Company shall pay such compensation for the pecuniary loss sustained as may be agreed, or as failing agreement may be determined by an arbitrator.

The limits of supply of the South Suburban Company are to be extended accordingly; and as from the day of transfer the price to be charged for gas within the added limits is to be a price per therm exceeding by not more than 3d. the price for the time being charged by the Company in the remainder of the limits of supply (other than the urban districts of Bexley, Crayford, and Erith).

There shall be distributed out of the assets of the Northfleet Company to the registered holders of the stock the sum of £1 in respect of each £1 of preference stock, the sum of £18 in respect of each £10 of the 10 p.ct. ordinary stock, and the sum of £12 for each £10 of the 7 p.ct. ordinary stock. Any remaining assets of the Northfleet Company after meeting all obligations and liabilities (including any costs and expenses of the transfer and of winding-up) and any other payments which the holders of the 10 p.ct. and 7 p.ct. ordinary stock may decide to make, shall be distributed among such holders in the proportions named above.

[*Parliamentary Agents: Messrs. Sherwood & Co.*]

WANDSWORTH, WIMBLEDON, AND EPSOM DISTRICT GAS COMPANY.

A CAPITAL CONVERSION BILL.

By the Wandsworth, Wimbledon, and Epsom District Gas Act, 1912, the Wandsworth and Putney Gas Light and Coke Company, the Mitcham and Wimbledon District Gas Light Company, and the Epsom and Ewell Gas Company were amalgamated, and the shareholders in the three Companies were incorporated under the name of the Wandsworth, Wimbledon, and Epsom District Gas Company. This Company were authorized to supply gas throughout the then existing limits; and for the purpose of connecting the mains in the Epsom limits with those in the Wimbledon limits, the Company were empowered to lay down and maintain certain lines of pipes in the parishes of Sutton and Cheam, within the limits of the Sutton Gas Company. By three subsequent Acts, further capital and other powers have been conferred upon the Company, who are now promoting a Bill for the conversion of the existing capital, to make new provisions as to charges for gas and the application of profits, and for other purposes.

As from Jan. 1, 1930, the following stocks, forming the whole of the issued ordinary capital of the Company, shall be converted into £1,180,970 of stock to be called "consolidated stock:" Wandsworth "A" stock, amounting to £30,000, and entitled to a standard dividend of 5 p.ct. per annum. Wandsworth "B" stock, amounting to £255,636, and entitled to a standard dividend of 3½ p.ct. per annum. Wandsworth "C" stock, amounting to £108,075, and entitled to a standard dividend of 3½ p.ct. per annum. Wimbledon stock, amounting to £352,000, and entitled to a standard dividend of 5 p.ct. per annum. Epsom stock, amounting to £98,000, and entitled to a standard dividend of 5 p.ct. per annum; and the new ordinary stock, amounting to £324,460, and entitled to a standard dividend of 3½ p.ct. per annum.

The amount of consolidated stock so to be issued by the Company in place of the various stocks named shall be divided in the following manner: There shall be issued to the holders of Wandsworth "A" stock consolidated stock at the rate of £129 for every £100; to the holders of Wandsworth "B"

stock, consolidated stock at the rate of £107 10s. for every £100; to the holders of Wandsworth "C" stock and of new ordinary stock, consolidated stock at the rate of £90 for every £100; to the holders of Wimbledon stock, consolidated stock at the rate of £105 10s. for every £100; and to the holders of Epsom stock, consolidated stock at the rate of £109 for every £100. The 3 p.ct. debenture stock, amounting to £88,416, and the 4 p.ct. debenture stock, amounting to £284,743 shall be converted and consolidated into 5 p.ct. debenture stock, and consolidated with the existing £207,500 5 p.ct. debenture stock. There shall be issued to the holders of the 3 p.ct. debenture stock 5 p.ct. debenture stock at the rate of £60 for every £100; and to the holders of 4 p.ct. debenture stock, 5 p.ct. debenture stock at the rate of £80 for every £100.

The power of raising additional capital conferred by the existing Acts of the Company, so far as the same has not been exercised, shall not be affected by the conversion of stocks effected by this Act, and may be exercised by the creation and issue either of consolidated stock or of preference stock, or wholly or partially by one or more of those modes. Borrowing powers are provided for up to one-half of the paid-up capital; and there is a clause to permit payment of commission on sales of capital.

Basic Price and Basic Dividend.

The declared calorific value of the gas is to be 470 B.Th.U. As from Jan. 1, 1930, the basic price of gas supplied is to be 11·4d. per therm. Except as by the Act otherwise provided, the Company shall not declare any larger dividend on the consolidated stock than at the rate of 5 p.ct. per annum; this being the basic rate. The surplus profits of the Company are to be divided in the proportions of four-fifths to the consumers and one-fifth equally between the ordinary stockholders and the employee co-partners of the Company.

The Company shall, from time to time, file for public inspection with the local authority, and with the Board of Trade, statements of the conditions under which they are prepared to grant discounts on prices charged by them; and they shall in each year send to the Board of Trade, with the accounts required under section 15 of the Act of 1920, a statement showing the number of therms sold at each of the several net prices during the year (including gas supplied to public lamps), and other information if requested. The accounts for each year must contain such particulars as will enable the local authority to calculate the amount which may be paid as dividend or transferred to the reserve fund, and paid to the co-partners.

The price to be charged by the Company for gas supplied by them to consumers by meter within the Wimbledon limits shall exceed the price under like circumstances within the Wandsworth limits by the sum of 0·6d. per therm, and no more. The price within the Epsom limits shall not exceed by more than 2·2d. per therm the price within the Wandsworth limits. If any increase shall at any time be found necessary in the price of gas, such increase shall be of the same amount throughout the whole of the limits of supply, and similarly in the case of any decrease. If at any time it is shown, to the satisfaction of the Board of Trade, that the costs and charges of, and incidental to, the production and supply of gas within the Epsom limits, are not as much as 2·2d. per therm in excess of the cost of production and supply in the Wandsworth limits, the Board of Trade may, on the application of the Company, authorize such a decrease in the actual price charged within the Epsom limits as will make the price in those limits not more than the actual amount of the excess in the cost of the production and supply of gas in those limits above the cost in the Wandsworth limits—provided that the price charged for gas within the Epsom limits shall never be less than 1·8d. per therm above the charge in the Wandsworth limits.

Prepayment Meter Charges.

With regard to prepayment meter charges, the following provisions are inserted:

> The charge for the hire of any prepayment meter and fittings to be used therewith shall be a sum of money calculated according to the number of therms supplied; and the maximum rate of charge shall be: For a prepayment meter and fittings (including a cooking stove), 3·6d. per therm; for a prepayment meter and fittings (not including a cooking stove), 3d. per therm.
>
> The following provisions shall be substituted for sub-section (3) of section 56 of the Act of 1912:
>
> The charge for the hire of a prepayment meter without fittings shall be either a sum of money calculated according to the number of therms supplied (when the maximum rate of charge shall be 1·8d. per therm) or at the rate of 10 p.ct. per annum on the cost of the meter, whichever shall be the higher.

There are clauses relating to lands; and the Bill contains a number of miscellaneous provisions, including extended power to enter premises to which a supply of gas is laid on, and for preventing the improper use of gas.

[*Parliamentary Agents: Messrs. Lees & Co.*]

(To be concluded.)

A JOYOUS PARTY

Photographed at East Greenwich.

Over a thousand children of the employees of the South Metropolitan Gas Company were entertained at a tea-party and pantomime by the Metrogas Amateur Sports Association in the Institute at East Greenwich on Thursday, Jan. 17. The photograph is a general view of the party.

ROAD TAR.

From a Paper by W. J. A. Butterfield, M.A., F.I.C., Assoc.Inst.C.E., before a Meeting of Municipal and County Surveyors at Leeds on Jan. 10.

The general adoption of tar as the bituminous road binder in this country may be said roughly to date from the competition which the Roads Improvement Association held in 1907 to determine "the best form of tar or preparation of tar suitable for road purposes." Whereas crude tar from the local gas-works had been fairly freely used as a surface dressing before 1907, it had been found that it was by no means as satisfactory and certain in its work as had been hoped for; and many road surveyors were already stipulating for "boiled," or "refined," or "distilled" tar. At that date the description of tar obtainable under either of these names nevertheless varied greatly according to the resources or views of its supplier. The Roads Improvement Association's competition in 1907, however, and pioneer work on the part of certain tar distillers, highway authorities, road contractors, and the suppliers of proprietary tar preparations, did much towards rendering available tar of more uniform grade and characteristics for both surface treatment and the making of tarmacadam. In particular, there was a definite movement against extension in the use of crude tar. Nevertheless, the tar offered in many instances to road authorities for some years after 1907 left much to be desired.

Advances in Quality of Road Tars.

Road Board and Road Department Specifications have gradually imposed more stringent requirements on the suppliers of road tar; but it should be stated that the larger tar distilleries have generally been in advance of the standard requirements, and in the last few years many of them have worked to their own more rigid specifications, in order to ensure that the tar they supply shall not merely be within the range of variation permissible in the standard specification, but shall be of a selected grade within that range. A stimulus in this respect has been afforded by the firms who supply certain proprietary tar preparations, of which "Tarvia" and "Tarco" both date from about 1907. The specifications which will be the British Standards for Road Tar this year have been brought forward by the British Road Tar Association as a further step towards the general improvement of road tars in this country.

The outstanding feature of the new Specifications is the higher consistency of viscosity of the tar, as compared with that previously supplied for the same purpose. This change has been made in response to the observation of many road engineers that the tars of higher consistency generally afford more durable work, and that, with due care and experience, they are not really more troublesome to apply than the thinner tars. Furthermore, they are usually less affected by extremes of heat and cold, and are less pervious to water and less capable of polluting it. There are a number of considerations, besides that of constructional efficiency, which properly sway the road engineer in his choice of bituminous material for road maintenance. Among these may be mentioned: Suppression of slipperiness in dry, wet, and even frosty weather, and inoffensiveness, directly or indirectly, through effluvium, dust, mud, or washings.

Slipperiness.

In so far as tar, as distinct from other forms of bitumen, is concerned, it may be said broadly that slipperiness appears to arise only when the gritting or blinding of the coating is at fault. The question of suitable gritting or blinding material needs careful study, but tar allows of a wide choice, because at ordinary temperatures it sticks to mineral matter which comes in contact with it. Some other forms of bitumen are hardly at all sticky at ordinary temperatures, and blinding or gritting material does not stick to a coating of such bitumen unless either it or the gritting material is warm.

Notwithstanding the superiority of tar over some other forms of bitumen in this respect, care must be taken in the selection of the gritting material, in order to avoid all risk of slipperiness to tyre or shoe. In the early days of road-tarring it was a common practice to sweep the road dust from the surface before tarring, and later to sprinkle the same dust on to the tarred surface, with or without additional dust, earth, chalk, or grit. Later, and especially in the case of previously tarred roads, dust-free grit or chips were used with much better effect. Nevertheless, one still finds occasionally local material which, when dry, consists to a large extent of impalpably fine dust, used to blind a surface dressing of tar; and while it serves the purpose of preventing "bleeding" or surface stickiness, it has the disastrous consequence of producing a smooth surface, which is polished by the action of traffic, and becomes slippery to shoes and hoofs even when dry. While dry powder, whether mineral or organic, will prevent bituminous materials sticking to metal, any surplus powder unabsorbed by the tar (or other bitumen) will act under traffic as a polishing powder or dry lubricant to cause tyres, shoes, and hoofs to slip on the smoothed surface. Gritting material, to be effective in preventing slipperiness, must be screened free from dust, and be in granules of ¼ to ¾ in., or even larger. Such material works into, and is retained by, a surface coating of tar. Tar which has set or hardened superficially has not normally a slippery surface; and if appropriate grit has been worked into it, there should be no serious risk of its becoming slippery either in dry or in wet weather. A coating of blown dust or leaves may temporarily produce slippery patches, but for these the real remedy lies in other obvious directions.

Frost will in no case render a tarred surface more slippery than another surface—one of the worst cases of skidding on an ice-filmed roadway which the author has witnessed occurred on the first Sunday last month on a short stretch of bare concrete surface, which became a death trap to which drivers were lured by the freedom from slipperiness of the adjacent tarred surfaces. Ice, formed rapidly after a slight thaw, had filled in all the depressions in the concrete surface, and left no inequalities on which the tyres could secure a grip, whereas the tarred surfaces, being normally smoother, had retained less moisture *in situ* for conversion to ice, and had yielded momentarily to the tyre sufficiently to afford it a grip. An asphaltic bitumen surface not far away was at the time also more slippery than the tarred surface, though less so than the concrete.

Inoffensiveness of Modern Road Tar.

Many allegations of effluvium, splashing, injury to vegetation, and contamination of rain washings have been made against tarred roads, and in the earlier years of road tarring, these were not unfounded. It may be safely predicted, however, that had other types of bituminous road binder been predominant in those early days, equally strong complaints, varying somewhat in nature, would have been levelled against the pioneer bituminous road dressing in its development stage. Even now, when road tar has grown out of the faults of its infancy, the public at large regards any black-surfaced road as a tarred road; and tar is often blamed for faults of smell, stickiness, and slipperiness which are those of bituminous materials of alien origin.

Effluvium and Injury to Vegetation.

Crude tar is apt to be offensive by reason of the ammonia evolved from the water or liquor which it contains; and, as already indicated, certain tars have given coatings which were offensive in hot weather through the fumes of naphthalene. Such tars, containing more than a trifle of ammonia and more than a small proportion of naphthalene, can no longer be supplied under the British Standard Specifications. For the rest, most people are accustomed to regard tar as having a "healthy," not unpleasant, smell, and very few acutely dislike it. Tar, once it has set on a road surface, is odourless.

Offence, through the sense of smell, does not, therefore, now arise with road tar. Broadly, it may be said that, while ammonia and naphthalene fumes from a crude tar have injured foliage in a few instances, such occurrences are now precluded by the improved character of British road tar. Any injury which can now arise will be such as other bituminous materials would cause in equal measure—viz., through the coating of foliage with extremely fine dust which is impregnated with bitumen. The injury would be somewhat akin to that caused by soot, or the blown-ash from furnaces (of which, with sulphur dioxide, a pronounced instance was recently before the Courts in connection with the Barton generating station of the Manchester Corporation Electricity Department). In degree, it would be so small as to be practically negligible. Some caution is necessary, however, to ensure that the emulsifying agents of bituminous emulsions are not of a nature to cause injury to vegetation either through fumes or, at a later stage, dust.

Contamination of Rain Washings.

Certain tars used in the early years of road tarring caused some annoyance because, in the conditions in which they were used, they produced a coating which was fluid and liable to splash; which formed an emulsion with rain water and the dirt used for blinding, and so yielded a black oily mud which stained everything it touched; and which was so pervious to, and miscible with, water, that rain washings became sensibly contaminated by constituents of the tar. The tars which did the most harm in these respects were mostly crude tars from local gas-works, but the highway authorities were often more to blame than the suppliers, because they persisted in some instances in buying tar at the lowest price at which they could obtain anything so-called, regardless of its grade or fitness for road purposes. It was considered by some Councils that an additional farthing a gallon for tar to put on the roads would be a shameful waste of money; and those engineers and distillers who recognized that tar needed careful selection and

preparation for its purpose had a hard fight to wage with the short-sighted sponsors of cheapness.

The cause of road-tarring is still suffering from the evil effects of the use of crude and unsuitable cheap tars between 1904 and 1911; and it is even now difficult to satisfy some of those who suffered then that the higher grades of road tars and tar preparations now available are not capable of causing similar ills. As regards fluidity and tendency to splash, little is now heard wherever reasonable care is exercised to secure good penetration, and adequate and suitable grit is applied. Some recent complaints of tar-splashes have, in fact, on investigation, been found to be splashes of inferior emulsions of asphaltic bitumen.

Tar and Fish Life.

The question of whether tarred roads are injurious to the fish-life and fish-food in waters to which the rain washings from the roads have access is a vexed one which is often obscured by preconceived assumptions. Laboratory tests of the material to be used for road surfacing are commonly misleading, because they do not take account of the effects of surface exposure, setting or hardening, blinding materials, extraneous deposits, and wear and tear. Some of these incidental circumstances render a material comparatively inoffensive which appears in the laboratory to be noxious to fish, while others result in rain washings being sensibly polluted, though the road-surfacing material itself does not injure fish in laboratory test vessels. It is unsatisfactory to draw conclusions from any trial which is not of a really practical character, and in which disturbing factors, such as varying contamination of the water from other sources, are not carefully excluded. The risk of damage to fish through rain washings from modern road surfacings lies primarily in the fine dust which motor traffic produces. This dust is extremely finely ground—much of it as fine as standard Portland cement—and is impregnated with oil and, if the surface is bituminous (either tar or asphaltic), with bituminous matter also. The dust is derived partly from the wear and tear of surface and tyres, but often largely from organic matter dropped or blown on to the roadway. It does not readily absorb water, but is carried off, more or less in suspension, by rain water. It is so fine and light that it passes with the water through some natural filtering media, and does not settle quickly to the bottom of still water. Consequently, it is often not wholly arrested before the road washings enter streams, and in them it may be found as a fine colloidal silt, which is injurious to fish and to aquatic life in general. There appears to be no sensible difference in the toxicity of this road surface silt, whether the surface consists of modern road tar, or asphaltic bitumen, or concrete. It is a product of the grinding action of tyres on a hard material, and its peculiar character is due as much to other colloids, such as fuel and lubricating oils and rubber, as to the actual materials used in the road surface itself. It is not a question usually of direct toxicity of present-day road materials, but of the colloidal nature of the fine silt, which gives it a potency towards fish life corresponding with the greater activity on the human system of a drug when administered in a colloidal condition.

British Road Tar Association.

It appears to the author that one of the most important functions of the newly formed British Road Tar Association and its District Boards will be to assist road engineers by affording advice as to how to use British road tar to the best advantage. Hitherto it has been assumed that the scantiest and most general directions suffice for the application of road tar, and it is really high testimony to its adaptability and utility that failures have nevertheless been so few. With other materials far more explicit instructions are given, and greater care is exercised in following them. British road tar will stand on its merits, as the paramount material for surface dressing, and for treating stone for non-urban roads, and has no need to disparage the utility of other road-making materials, each in its appropriate sphere. The author believes that the more co-operation there is between the highway engineer and surveyor and the suppliers of British road tar and its preparations, the better it will be for British industries as well as for British roads.

CO-OPERATIVE CONTROL OF COAL PURCHASES BY GAS-WORKS.

By P. E. Raaschou, Professor in Applied Chemistry, Royal Technical College, Copenhagen.

[From a Paper before the Second International Conference on Bituminous Coal, Pittsburgh, Pa., Nov. 19 to 24, 1928.]

It is of universal interest for the coal producing as well as the non-coal producing countries that every effort is made in attaining a rational utilization of coal for its many applications, and to endeavour to use for each special application the particular grade only, which is best fitted. This latter is naturally of vital importance to gas and coke works.

Large consumers, who are in possession of well-equipped laboratories, and who have at their disposal scientifically trained chemists, can easily maintain scientific coal control, whereas many medium sized and small consumers, whose total consumption does play a prominent part in the fuel economy of a country, in most cases are unable to handle such a task by themselves. These small consumers have more use for simple and practical specified methods, which can be performed without the assistance of scientifically trained minds, and from which it is possible, in a comparatively short time, to obtain analytical results of sufficient accuracy, than for methods which give results with an accuracy of several decimals. Furthermore, it is of the greatest importance to these consumers, in judging the quality of the coal available on the market, to get an opportunity for comparing their analytical results.

Standardization of Methods.

The problem has therefore been to work out simple analytical methods which could be standardized, and to organize co-operative utilization of the results gained. I will outline briefly the present arrangement which the Danish Gas-Works Association, members of which are mainly municipal works, have established, and which for the last four years has been working to the fullest satisfaction of the members involved, and is now intended to be further developed.

The manner of proceeding is, briefly, that the gas-works in following a standardized method takes out average samples from all coal deliveries, and then tests these samples in accordance with the standardized methods made specifically for this purpose, which enables them to make proximate analysis, and to draw valuable conclusions about the quality of the coke which can be produced from the coal tested. The results of these analyses, as well as all information in regard to the shipment of the coal, such as the name and location of the mine from which the coal was shipped, the quality shipped, the general condition of the coal as to size and dryness, &c., is forwarded to the Association which then, without any delay, prints all the data on special blanks. As soon as these blanks are filled they are distributed to all the active members in the corporation, and in this way it is made possible for them to be familiar with all the valuable information regarding coal available on the market, and accordingly be governed in future purchase of coal.

From the ash and water content in coke, the calorific value can be calculated with good approximation, while a rough calorific value of the coal can be determined from the results of the approximate analysis. It would, of course, also be of great importance to be able to include a sulphur determination in this series. However, so far it has not been possible to simplify this determination to a point where it can be made quickly and safely by a person untrained in chemistry. All sulphur determination for coal from the various gas-works is therefore made at a central laboratory.

Co-Operative Control.

It is the intention of the Gas-Works Association in the future also to have the determination of the fusing point of ash in oxidizing atmosphere included in this series of testing, as this determination is very simple.

The co-operative control has induced many gas-works to use grades of coal which are much better adapted to the production of coke than they previously used, and it has been proved that some miners have made a special effort by introducing improved methods for cleaning and sorting the coal at the mine, to satisfy the more rigorous demands now put up by the gas-works. While most of the gas-works previously aimed at getting a coal which gave the largest amount of gas simultaneously with cokes which were barely useful, they are now paying considerably more attention to the quality of the coke, and are trying to buy coal which not only gives a large amount of gas, but at the same time produces a low ash coke of the very best quality. This change in the viewpoint of the gas-works, which has been the first practical result of the educational influence of this co-operative system, has in several cases been of great economical advantage, and it has forced the importers to raise the quality of their coke in order to stay on the market. By using coal low in sulphur, several of these gas-works have been able to increase the capacity of their gas purifying installation, while in some cases extensions of these have been avoided.

The establishing of such an arrangement as made by the Danish Gas-Works Association has naturally opened up many possibilities for more extensive co-operation in solving the many, both technical and economical, problems which the gas-works meet with in their daily life.

FUEL AND HIGH-PRESSURE GAS RESEARCH AT THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.

Development Outstrips Accommodation.

Last week, under the guidance of Prof. W. A. Bone, D.Sc., Ph.D., F.R.S., under whose direction the Department of Chemical Technology was inaugurated in 1912, we inspected the unique equipment for fuel research—particularly for dealing with problems relating to high-pressure gas reactions and gaseous combustion and explosions—in the laboratories of the Department. The history of the Department has been one of rapid progress; and the continuous growth has rendered the present accommodation wholly inadequate to meet the increasing needs of its work and activities—this in spite of the fact that since the war the size of the laboratories has been doubled. A scheme for further enlargement of the building has been approved, and will be carried out as soon as the means are available. It will be recalled that the Gas Light and Coke Company and Radiation Ltd, have established Gas Research Fellowships in the Department.

The Department of Chemical Technology at the Imperial College of Science and Technology now comprises three Sub-Sections. These are: (i.) Fuel Technology with Refractory Materials, Combustion, and High-Pressure Gas Reactions and Explosions; (ii.) Chemical Engineering; and (iii.) Electrochemistry. The Department was inaugurated in October, 1912, under the direction of Prof. W. A. Bone, as the outcome of the recommendation of a Sub-Committee appointed by the Governing Body of the College in 1907 "to consider the future organization and development of other pure and applied sciences in the College." "Chemical Technology" was chosen as its name at the suggestion of the late Sir Edward Thorpe, F.R.S. (then Professor of Chemistry at the College), as best denoting the breadth of its scope and aims. It should be noted, however, that the needs of Chemical Engineering, which were included from the outset in the Scheme, have recently been further met by the establishment of a special Chair with separate budget in that subject; and at the same time an Assistant-Professorship in Electrochemistry was established.

SCHEME FOR ENLARGEMENT.

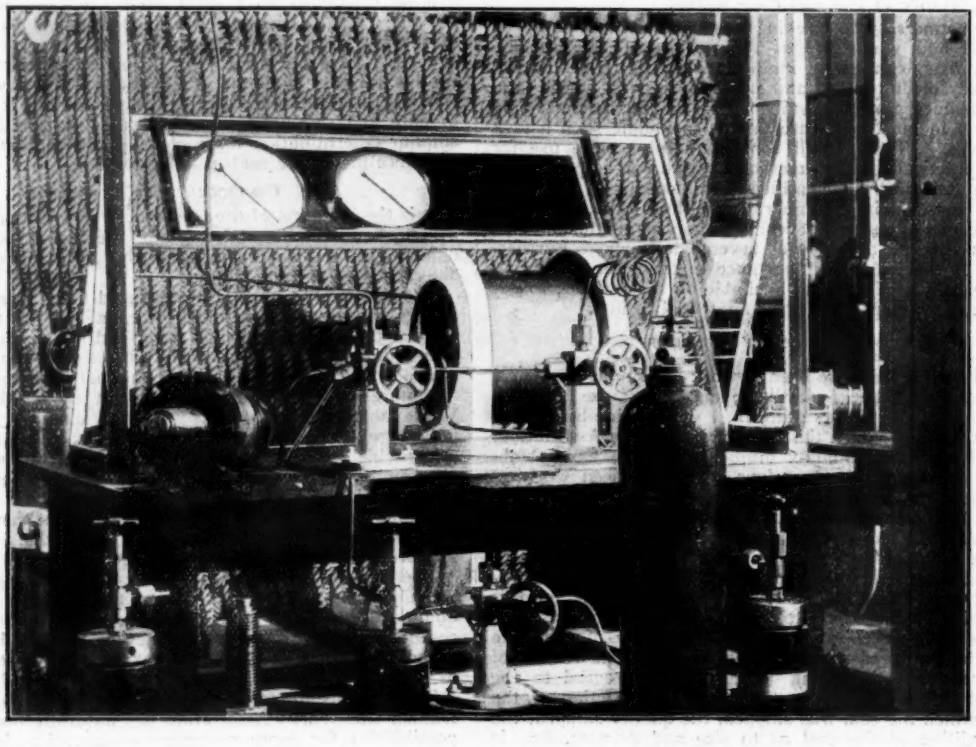
The first two storeys of the present Departmental Building (providing for fuel technology, and in part for chemical engineering) were erected in 1913, and were described and illustrated in the "JOURNAL" for May 18, 1915, p. 390. After the war two more storeys (for chemical engineering and electrochemistry) were added to it; but the continuous growth of the Department, and more particularly its research developments, have rendered the present accommodation inadequate for the increasing needs of its work and activities. A scheme for the further enlargement of the building, which will provide further much needed accommodation for research, has been approved, and will be carried out as soon as the required money is forthcoming. The capital expenditure on buildings and equipment to date has been approximately £60,000; and about £50,000 more is now required for the extension contemplated.

The teaching staff at present numbers seven—namely, the Organizing Head of the Department (Prof. Bone, who is also in special charge of the Fuel Technology Section), a Professor of Chemical Engineering (Prof. J. W. Hinchley, A.R.S.M., Wh.Sc., F.I.C.), an Assistant-Professor of Electrochemistry (Mr. G. I. Finch, M.B.E.), together with three lecturers and an instructional assistant. In addition there is a staff of four skilled mechanics, with the resources of a fine modern workshop, to look after the equipment and make apparatus needed for research work.

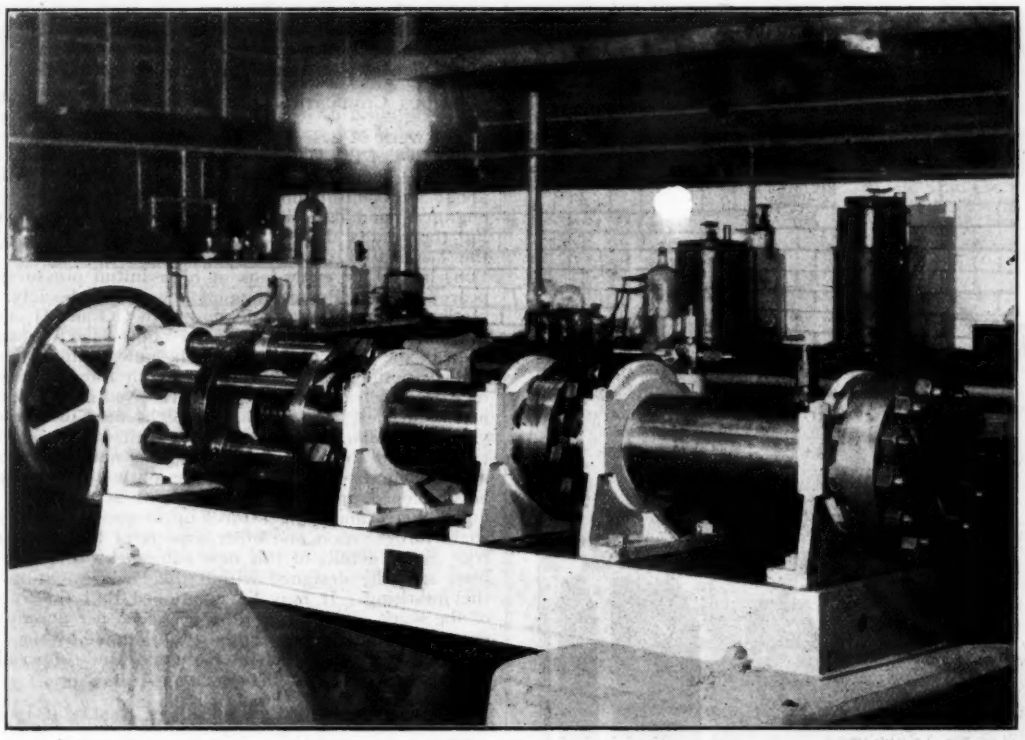
AIMS OF THE DEPARTMENT.

The work of the Department is exclusively of a post-graduate and research character; no student being admitted who has not already graduated (in chemistry as principal subject, with mathematics, mechanics, and physics as subsidiary subjects) either at the Imperial College or elsewhere. It is chiefly directed to giving such post-graduates a broad and practical training on fundamental lines, including research experience, of a sort calculated not only to widen their knowledge, but also to develop their personalities and special interests, so as to fit them for responsible positions in industry, either in regard to plant control and management, or as research chemists, or even on the commercial and economic side of chemical and fuel industries.

At present there are working in the Department fifteen first-year, full-time post-graduate students; ten second-year, full-



SUPER-PRESSURE EXPLOSION BOMB (WITHSTANDING PRESSURES UP TO 15,000 ATMOS.) TOGETHER WITH GAS FILLING SYSTEM AND OTHER ACCESSORIES.



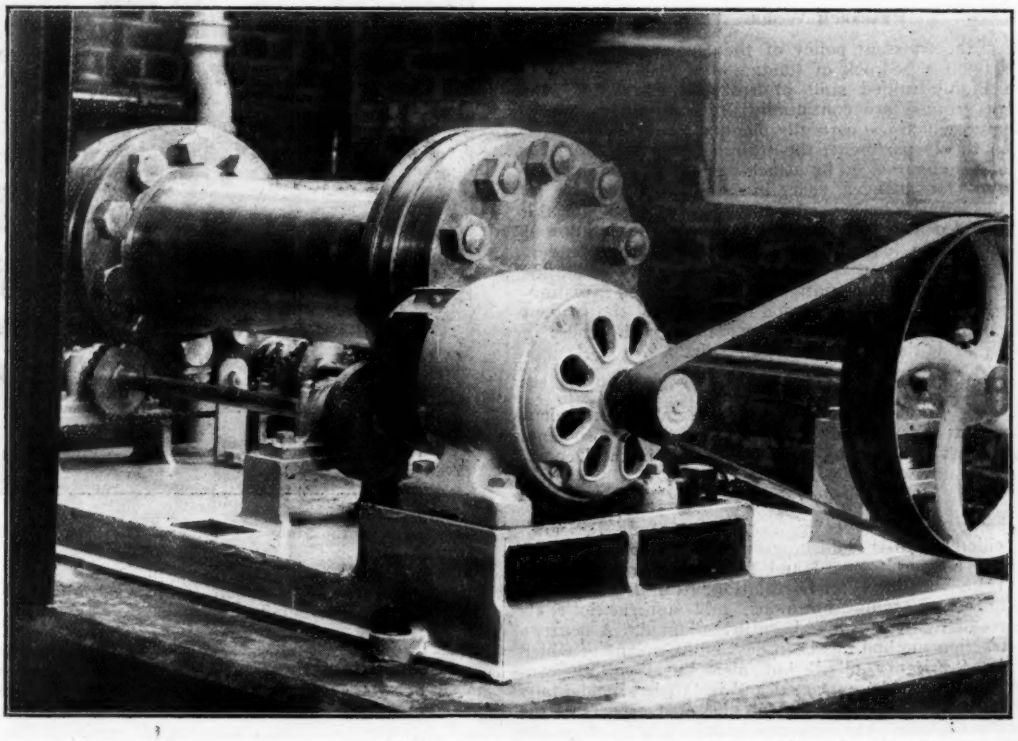
APPARATUS FOR INVESTIGATION OF GASEOUS REACTIONS UNDER PROGRESSIVELY INCREASING TEMPERATURES AND PRESSURES.

time post-graduate research students, and eighteen paid, full-time research assistants and Fellows, besides sundry occasional students. So that, counting in the teaching staff, who are also all engaged in directing research work, there are fifty people continually prosecuting scientific and technological studies in the Department, at a total running cost (including salaries, wages, apparatus, and material) of approximately £13,000 per annum, of which about £7000 is defrayed out of the ordinary College Funds; the remainder coming in the form of aids and grants from various extra-mural sources.

Since its inauguration, upwards of 150 post-graduate students have already passed through the Department. Most of them are occupying responsible posts as fuel technologists, plant managers, chemical engineers, or research chemists in industrial concerns. Also they have been drawn from many parts of the Empire and the world, including, among others, Australia, Canada, India, South Africa, the United States, China, and Japan.

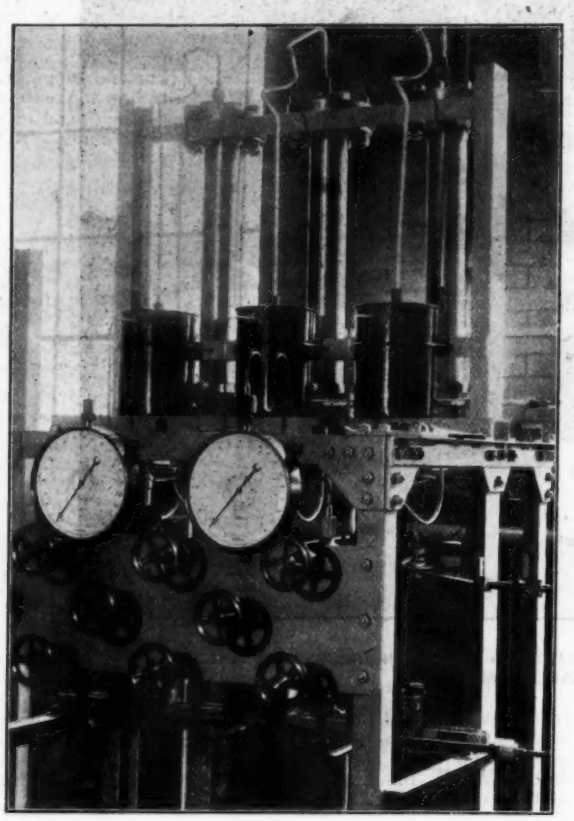
TRAINING.

Throughout the courses, stress is laid on a student's acquiring a knowledge of the economic and historical, as well as of the chemical and mechanical, aspects of industrial processes and developments, and on his becoming skilled in chemical manipulation and laboratory arts. Also, the importance of a chemist being somewhat of a geologist is insisted upon. In



HYDROGENATION UNIT.

the Fuel Laboratories, he is taught to carry out the chemical analyses of fuels and refractory materials, gas analysis, fuel pyrometry and calorimetry, tar distillation, &c., with accuracy and despatch; and in the Research Laboratories, efficiency in operations such as glass-blowing, and the purification, liquefaction, and rigid drying of gases, is insisted upon. In the Chemical Engineering Laboratories, students are trained in the use of hand tools. Indeed, in all sections of the Department, the importance of good handicraft and of accurate analytical work is stressed.



Multiple Unit High-Pressure Catalytic Circulating System.
(Pressures to 1000 atmos.; temperatures to 600° C.)

Research Work.

It has been the constant policy of the Department to base its activities upon a bedrock of fundamental research; and it now has a highly-trained staff of research assistants who (organized in groups) are continually prosecuting systematic lines of research which are carefully planned in advance. After two terms in the Department, the training of a would-be research student is commenced by attaching him to one or other of such groups for about a year, in order that he may be thoroughly disciplined, both in the methods involved and the accuracy demanded in research operations, before he is allowed either to start off on his own or to become a group leader. In this way, not only is there assured a continuity of skilled workers requisite to the systematic and uninterrupted investigation of selected subjects over a period of years, but the student himself learns the value of close co-operation with others in research, as well as the benefits of leadership.

Principal Lines of Research Work.

The following principal lines of fundamental work, calculated to direct students' minds to some of the basic problems of chemical industry, are being actively pursued in the Department.

Chemistry of Coal.

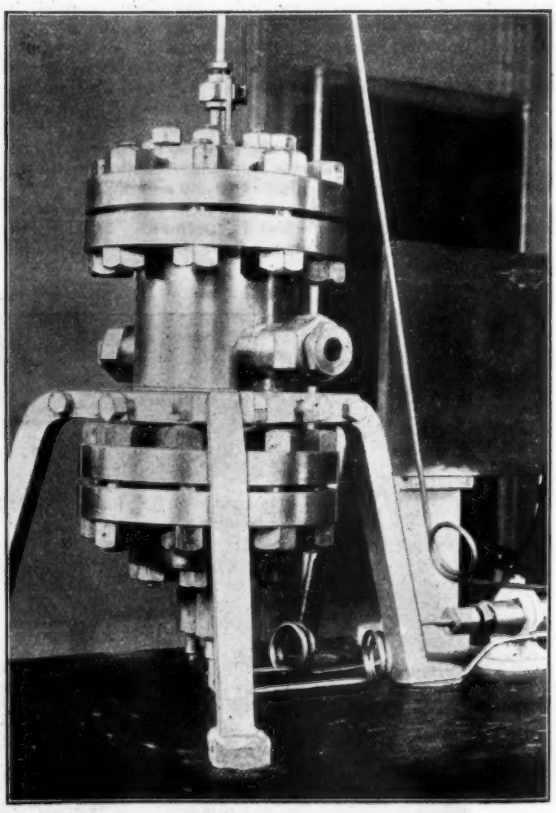
This is being carried out by a group of four Research Assistants, chiefly with the aid of grants of £1000 per annum from the Fuel Research Board and a Fellowship with £250 per annum from Sensible Heat Distillation, Ltd. Brown coals, lignites, bituminous, semi-bituminous, and anthracitic coals from all parts of the world have been investigated. A benzene pressure-extraction method has been devised by means of which not only the "primary oils," but also the "coking constituents," of coals can be extracted and isolated. Incidentally much light has been thrown upon the chemical aspects of the maturing of coals. Another outcome of the work has been the discovery that the "coal residue" remaining after the benzene pressure-extraction can be oxidized by means of alkaline permanganate, yielding about 40 p.ct. of its weight of benzene carboxylic acids. The results of these researches have been published in a series of six papers in the Proceedings of the Royal Society; and the work is being extended.

Gaseous Combustion and Reactions at High Pressures.

The work of gaseous combustion at high pressures, which is distinctive of the Department, has been continually in progress since the war, and at present four Research Assistants and about an equal number of research students-in-training are engaged upon it. Already a series of twelve papers embodying the results thereof (which have included the discovery of the "activation of nitrogen," and consequent large NO-formation, in CO-air explosions at high initial pressures) have appeared in the Proceedings of the Royal Society. The first section of the research—dealing with CO-air, H_2-air, CH_4-air, &c., explosions at initial pressures up to 200 atmospheres—has been in the main completed. The new equipment recently installed in the High-Pressure Research Laboratories, at a cost of £3500 (defrayed out of grants received from Imperial Chemical Industries, Ltd., and the Gas Light and Coke Company) provides, *inter alia*, for its extension to still higher initial pressures (200 to 1000 atms.). In addition, this new equipment will enable systematic fundamental research work (already begun) to be developed upon catalytic reactions at pressures up to 1000 atmospheres and temperatures up to 500° C., as well as upon coal-hydrogenation and other aspects of high-pressure chemistry. Some details of this new equipment—most of which has been specially designed within the Department—are given in the following. It may be mentioned that the running costs of the work (amounting to over £2000 per annum) are being defrayed chiefly out of annual grants made by the Department of Scientific and Industrial Research, and Imperial Chemical Industries.

Equipment of High-Pressure Gas Research Laboratories.

The equipment, which has been purchased out of grants from Imperial Chemical Industries, Ltd., the Gas Light and Coke Company, the Department of Scientific and Industrial Research, and the Government Grant Committee of the Royal Society, comprises chiefly:



Apparatus for the Study of Continuous Flames at High Pressures.

(*a*) Two 100-c.ft. and seven 10-c.ft. gasholders; two gas compressors (a two-stage unit for 200 atmospheres, and a five-stage unit for 1000 atmospheres); storage cylinders; pressure balances for calibrating standard Bourdon gauges; and apparatus for determining the compressibilities of gases.

(*b*) Two experimental units for high-pressure catalytic work

up to 500° C. and 1000 atmospheres; apparatus for determining equilibrium conditions in gas-vapour systems at high pressures and temperatures up to 500° C.; and an experimental unit for maintaining electric arcs in gaseous media at high pressures.

(*c*) High-pressure gas explosion bombs with filling systems; and Petavel manometers and spectrograph for initial pressures up to 100, 200, and 1000 atmospheres respectively.

(*d*) Apparatus for investigation of continuous flames at pressures up to 100 atmospheres.

(*e*) Apparatus for investigation of gaseous reactions under progressively increasing temperatures and pressures.

Development of Gaseous Explosions.

Photographic researches upon the development of gaseous explosions are now being prosecuted in the laboratories under the auspices of Nobels Explosives Company, Ltd., who are paying for the Senior Research Assistant (Mr. R. P. Fraser, formerly the Radiation Research Fellow) and other incidental expenses involved. Already four papers have been communicated to the Royal Society on the subject. Up to now the work has included the investigation of phenomena associated with the initial stages of gaseous explosions, and the influence of "shock waves" in speeding up combustion and developing detonation; and it is now being extended to the investigation of the influence of strong electrical and magnetic fields upon flame-propagation in gaseous explosions.

Combustion of Carbonic Oxide.

Much fundamental (including spectrographic) work has been done (with the aid of two Gas Research Fellowships maintained by the Gas Light and Coke Company and Radiation, Ltd., respectively) chiefly upon the mechanism of CO-combustion, particularly with reference to the influence of moisture thereon, which has been shown to be not so much chemical as electrical. And work on other aspects of combustion is in progress. Five papers on the subject have already been published in the Proceedings of the Royal Society. It may be mentioned that the present Gas Light and Coke Company Research Fellow is Mr. S. G. Hill, and the Radiation Research Fellow is Mr. F. Lake.

Blast-Furnace Reactions.

This research on the fundamental reactions involved in blast furnace iron smelting (a revision and extension of Lowthian Bell's classic work of fifty years ago) is being carried out under the auspices of the National Federation of Iron and Steel Manufacturers, who are paying the staff of four Research Assistants and other expenses involved. A first report of the results of this work—covering the interactions between the furnace gases and the ore at temperatures between 350° and 650° (and particularly the phenomenon of "carbon-deposition," $2CO \rightleftharpoons C + CO_2$, the optimum temperature for which is 450° C.)—was published in the Journal of the Iron and Steel Institute in 1927. Since then it has been extended to higher temperatures, and, *inter alia*, a new experimental furnace has been designed and installed which will enable the chemical phenomena of the blast furnace to be experimentally studied not only at high temperatures, but also with gas velocities equal to those actually attained in the blast furnace itself. At present the chief problems being investigated are (i.) the relative influences of carbonic oxide and of the finely divided carbon resulting from "C-deposition" in reducing the ore at temperatures between 650° and 1200° C.; and (ii.) the influence of moisture and hydrogen upon "carbon-deposition" and other furnace reactions generally, with a view to explaining the well-known efficiency of "dry blast" in the furnace.

Gaseous Combustion in Electrical Discharges.

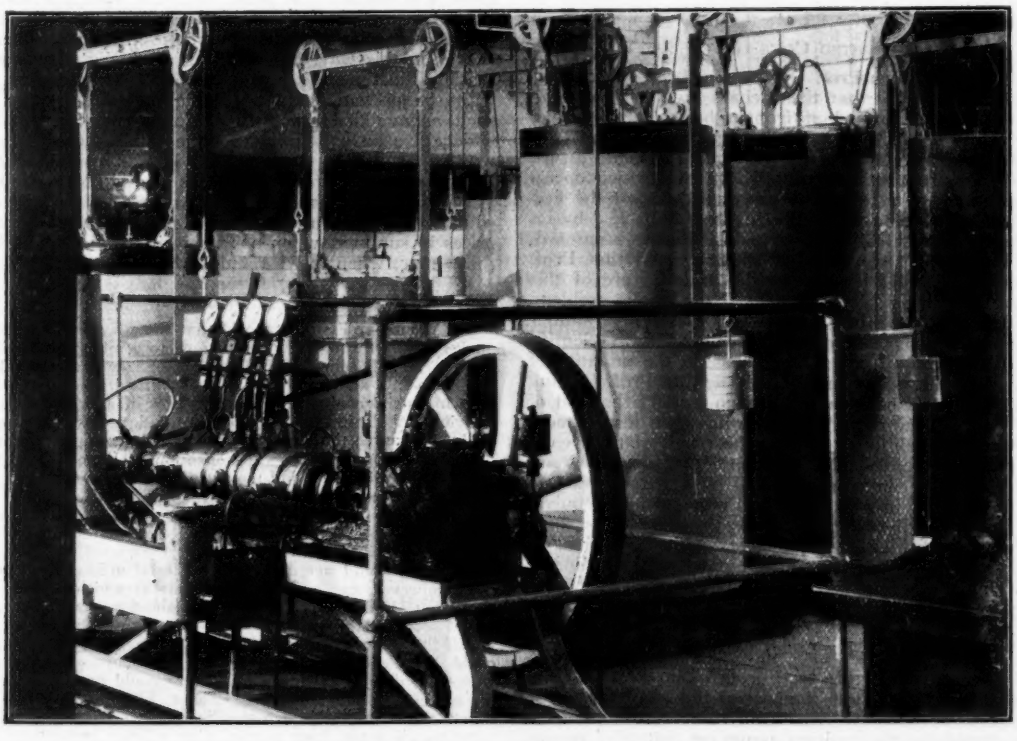
This, and the electrical condition of surfaces during catalytic combustion, are being carried out, under the direction of Assistant-Prof. G. I. Finch, by a group comprising one Research Assistant (provided by the Department of Scientific and Industrial Research) and three research students. Several papers embodying the results, which are of considerable fundamental interest, as showing that combustion is conditioned by a prior ionization of both the combustible gas and the oxygen, have already been published in the Proceedings of the Royal Society, and more will follow soon.

Chemical Engineering.

In the Chemical Engineering Laboratories Prof. Hinchley, assisted by three research students, is investigating fundamental problems connected with heat transmission and filtration. There is a great need of the problems of chemical plant design and operation being systematically investigated from a fundamental standpoint in this way; and the contemplated further extensions of the present building and equipment would enable more to be done in this direction. It should also be noted that arrangements have been made with the Distillers' Company whereby they maintain a post-graduate studentship in chemical engineering, and also send certain members of their technical staff to spend a year working in the Chemical Engineering Section under Prof. Hinchley's direction.

Need of Building and Equipment Extension.

A point has now been reached when the activities—and more especially the research work—of the Department cannot be further extended and developed unless its building and equipment are enlarged. In all three Sections of the Department there is plenty of work lying on the doorstep, so to speak; and there are plenty of post-graduate workers eager to do it, if such further accommodation can be provided. Indeed the Department will have either to extend the building and equipment or refuse such further work and admission. And to provide at



GAS PREPARATION LABORATORY, SHOWING STORAGE HOLDERS AND 1000-ATMOS. FIVE-STAGE COMPRESSOR.

all adequately for the development of the work within the next five years, a capital expenditure of £50,000 will be necessary.

INSPECTION OF THE DEPARTMENTAL WORK AND EQUIPMENT.

On Monday afternoon last, by special invitation of the Governing Body and Rector of the College, a representative company of scientific men, industrial leaders, and others interested in the work of the Department, inspected its work and the newly equipped high-pressure gas research laboratories. All sections of the Department were thrown open to the visitors. Profs. W. A. Bone, J. W. Hinchley, and G. I. Finch, together with all members of the teaching and research staffs, conducting the guests round the various laboratories in which research work was in progress; tea being served in the Lecture Room during the proceedings.

Great interest was manifested in the new equipment, as well as in the various demonstrations and exhibits illustrative of the researches in progress. It may be added that during the next few weeks Prof. Bone and staff will be pleased to receive other visitors who would like to be shown over the Department by appointment any day between the hours of 3 and 5 p.m., provided that due notice (Telephone, 4262 Western) is given.

THE DOMESTIC SMOKE PROBLEM: A PRACTICAL SOLUTION.

Another contribution towards the solving of the domestic smoke problem was made by Prof. C. R. DARLING at the Royal Society of Arts on Wednesday, Jan. 16, when he dealt with the whole problem of domestic smoke, and gave interesting details of experiments he has carried out with a new type of stove for burning gas coke, with which he has now had practical experience for two years. The meeting was largely attended, and Dr. MARGARET FISHENDEN, of the Industrial Research Division of the Department of Scientific and Industrial Research, presided.

Prof. Darling necessarily went over a good deal of familiar ground, in which he referred to the affection of the average Britisher for a coal fire—mainly, perhaps, because it is something that can be poked; but also for the reason that, *quâ* fuel, the coal fire is cheaper for continuous burning. Having this latter point more in mind as a primary consideration, Prof. Darling has applied his investigations to the question of cost coupled with equivalent or improved heating; and he claimed that, as a result, the domestic smoke problem may be regarded as definitely solved. In order that a full appreciation may be had of the results which were put forward, it is necessary to study the following table relating to the various methods of domestic heating; the problem being to provide a heating device which may replace coal fires in all types of houses, remembering at the same time that in most cases any addition to the weekly budget would be a fatal drawback. The usual calorific values have been assumed, and the figures relate to South-East London.

Source of Heat.	Cost.	B.Th.U. for 1 Penny.
Gas coke	37s. per ton	60,000
Household coal	48s. ,, ,,	57,000
Low-temperature carbonization coke	52s. ,, ,,	45,000
Anthracite coal	69s. ,, ,,	40,000
Coal Gas	8⅔d. per therm	11,400
Oil for oil stoves	1s. 2d. per gallon	11,400
Electricity	1d. per unit (kilowatt hour)	3,415

A GAS-LIGHTED COKE GRATE.

The fireplace with which Prof. Darling has been experimenting has the novel feature that the firebars are inclined at an angle of 30° to the horizontal from front to back. The fire uses gas coke which is lighted by gas in the first instance; a series of burners being arranged underneath, and the gas being turned off after the coke has been thoroughly lighted, which operation takes about 15 minutes. The sides and back of the fireplace are lined with firebrick, which, in turn, is backed by insulating bricks. Broken coke from 2 in. to ¾ in. has been used, and found successful. It should at once be said that Prof. Darling has no financial interest in the manufacture of this particular grate, and, as a keen student of the smoke problem, he would welcome any other type which would give similar results. No attempt has been made to test the fire with scientific appliances, and therefore actual figures as to the quantity of heat radiated into the room cannot be given; but Prof. Darling suggested that it could be assumed that 30 p.ct. of the heat of the coke is given to the room. The fire has been tested under ordinary domestic conditions; and as the result of two years' use in all types of weather, it has been found that the temperature of the room can be maintained by a consumption of gas coke not exceeding in weight the coal required in an equivalent fire. The financial saving in fuel is therefore represented by the difference in price between coke and coal, which, of course, varies according to the locality, but which, according to the table given above, would be an economy of 25 p.ct. in favour of the coke. There are, however, many other obvious advantages.

IF COKE REPLACED COAL.

After pointing out how this type of fire can be applied in houses of all classes, and how the cost of the gas for ignition will be counterbalanced by the saving in chimney-sweep's fees, the lecturer considered the position assuming that all domestic coal fires were replaced by coke fires. At the moment, the amount of gas coke available for domestic use would be inadequate to meet the supply. The total production of gas coke throughout the country is roughly 12 million tons, of which more than 3 million tons is used for heating retorts, &c., in the works. About 2 million tons of the remainder is either converted into water gas or exported; but even if the latter quantity were used for domestic purposes instead of being exported, the total supply would only be 9 million tons, as against a coal consumption of 36 million tons. In London, the corresponding figures are about 3 million tons of coke and 8 million tons of coal. Therefore, further supplies of suitable fuel from some other source are essential if domestic smoke pollution is to be completely solved. An obvious method, said Prof. Darling, would be to carbonize more coal, but this must be on an economic basis. Low-temperature coke must be sold at as low a price as gas coke in order to compete; but the view was also expressed that the fact that gas coke can now be burned satisfactorily in the open fireplace has completely altered the outlook from the point of view of low-temperature coke, and that there is no need now for a semi-coke, less durable and occupying more cellar space than gas coke, for domestic purposes. A treatment of coal which gave the necessary yield of oils, &c., but left a residue of the nature of gas coke, if economically sound with regard to the disposal of the bye-products and gas produced, would thus effectively solve the difficulty of the shortage of solid smokeless fuel.

PLAN OF ACTION.

In conclusion, Prof. Darling outlined the following definite plan of action to abolish domestic smoke, having regard to existing and future conditions. First, we must remove the ordinary coal fire from the designs of all new houses, of whatever size, putting in its place a smokeless fireplace. This is a matter which specially concerns local building authorities and medical officers of health, who should use their full powers to secure this change. Secondly, efforts should be made to induce landlords and tenants of existing houses to convert the grates at present in use into the smokeless variety. The rate of progress will naturally depend upon the efforts made; but, as Prof. Darling pointed out, a persistent campaign is bound to lead to a notable reduction of smoke in a short time. Making a start in this way, and working gradually, it was anticipated that by the time the consumption of gas coke has caught up with the present supply, suitable fuels from other sources—such as modified processes of low-temperature carbonization which give an end-product of the same nature as gas coke—will be available. Incidentally, it was pointed out that the greater demand for coke and gas should bring about a reduction in price of both; though, as a final remark, Prof. Darling pointed to the anomaly in the coal trade which results in low prices in summer, when nobody wants coal, and high prices in the winter, when the demand is the greatest.

Discussion.

Dr. MARGARET FISHENDEN said that though some progress had been made, mainly through the aid of gas, to combat the smoke problem, there were still some 40 million tons of raw coal burned in private houses to-day, and, moreover, it was burned much more inefficiently than industrial coal. Given the features of a fireplace, such as that described by Prof. Darling, so far as design was concerned, she was inclined to agree that ignitability was not, perhaps, the main feature to look for in gas coke. The criterion of a good coke would then probably be a low ash and moisture content, because in such circumstances as those outlined by Prof. Darling it would be possible to burn not only gas coke, but even a harder coke. Work in that direction had been done at the Fuel Research Station. Metallurgical coke could be ignited if sufficient gas were used, though a few cubic feet of gas would not make any material difference in cost. There were, however, cases in which the rate at which the coke fire could be made to light was of importance; and here low-temperature cokes would score. Moreover, they could be lighted by the methods with which the ordinary housewife was familiar. Low-temperature cokes could be used in existing grates, which was another advantage where the cost of changing the grates could not be undertaken. At the same time, low-temperature cokes, like gas coke, varied according to the coal from which they were made; and they might be disagreeable if made from a coal with a large percentage of ash. A question which would require consideration was the disposal of the

large quantity of other products involved in the production of such quantities of gas coke as had been mentioned. It would be necessary to enlarge the present gas-works. However, if the demand was to be met, it would mean new plant of some kind; and it seemed that the gas industry was best fitted to carry out this work, whether it be by high or low temperature methods. Nevertheless, she was not so optimistic as Prof. Darling in thinking that the problem was entirely solved, because it was not merely necessary that coke should burn. It should also do its job; and though coke was satisfactory for hot water production, it sometimes failed to heat the oven. In some cases it would be extravagant to cook by gas, because the kitchen range had to be kept going all the time; and this was a point to which manufacturers of coke burning apparatus might turn their attention.

Mr. LL. B. ATKINSON recalled that forty years ago Sir William Siemens designed a coke fire ignited by gas in much the same way as that described by Prof. Darling, and had it burning in his office in Westminster. Why it was not developed, he did not know. Among other methods of heating in his own home, he was using "Coalite," which certainly burned satisfactorily in an ordinary fire; and during the war he had burned ordinary gas coke in open fireplaces. The broad issue, however, was how much longer they were to endure this smoke nuisance, with its effects upon health and property. They did their best to hide the sun from their towns and cities, and then spent money in obtaining artificially the ultra-violet rays which they ought to get from the sun. His view was that the smoke nuisance in this country would never be cured until they took the drastic measures that had been taken in other countries—*i.e.*, legislation. He did not suggest that it would be fair to prohibit the burning of raw coal until alternative fuels were available; and the Fuel Research Board were endeavouring to provide those alternative fuels.

Mr. A. H. BARKER agreed that the only way to deal effectively with the problem was by legislation, as the individual felt he was being asked to spend money in new grates for the benefit of his neighbours. At the same time, there must be alternative fuels available. One of the most important ways for reducing smoke was to increase the use of gas; and he did not see why the gas fire should not be made the equivalent of the coal fire. Frankly, he could not disguise from himself that the gas or coke fire did not have the same attraction as the coal fire; and this must be taken into account. There was an "exquisite pleasure" in a coal fire. Being closely interested in heating problems, his own house was fitted so that he had four alternative methods, and he was able to change from one to the other at will. At the same time, he uttered a warning with regard to the acceptance of comparative figures of cost, owing to the differences in local cost, methods of use, and so on.

Major P. H. RICHARDSON said he had been in the gas industry for most of his life, but was now interested in the manufacture of apparatus for burning smokeless fuel. So far as gas coke was concerned, he had always impressed upon gas engineers that there would not be a greatly increased use of this until the ash and moisture content was reduced. Gas coke possessed from 15 to 23 p.ct. of ash, and absorbed water to such an extent that, though as manufactured it might have only 7 or 8 p.ct., it would subsequently absorb anything up to 20 p.ct. of moisture. At the same time, it must not be assumed that he was antagonistic to gas coke, because he was interested in making apparatus for burning it. Personally, he would welcome legislation which laid it down that in three years—not ten years—ordinary coal must not be burned in domestic grates.

Mr. ARNOLD MARSH (Secretary of the Smoke Abatement League) said that cokes with 20 p.ct. of moisture were suitable for burning in open grates, and that modern vertical cokes would burn in well grates. Tests in Manchester with vertical coke had shown satisfactory results provided suitable draught regulating appliances were fitted to avoid constant re-fuelling. The problem, however, would only be solved by providing an alternative fuel which was cheaper than coal. He believed that in the near future, owing to the reduction of transport charges, low-temperature fuels would be available at cheaper prices; and then greater progress would be made, because it was impossible for the people in small houses to think of replacing all their grates to burn gas coke, and low-temperature coke could be burned in ordinary grates.

Prof. DARLING, in his reply to the discussion, agreed that the inability of the poorer people to pay for installing the most up-to-date appliances lay at the root of this problem. His feeling about low-temperature coke was that it was always coming, but it never seemed to come in sufficient quantities to make any difference; and the whole object of his experiments and his paper was to accelerate the movement. He claimed that he had shown one way of burning gas coke cheaply and satisfactorily in an open grate; and there were 3 million tons of gas coke available for domestic use in London. If a start were made, then the movement would progress by its own force. Anthracite was used in New York; but the average wages in New York were higher than in London, and people in London simply could not afford to use anthracite, owing to its high price. All the manufacturers of such apparatus as he had described should get together and produce something which could be used in large numbers, instead of each advertising against each other and making little progress. It was possible to make a start at once by using any of the appliances now available. It would be impossible to enforce legislation until alternative fuels were available at a price which people could afford; but the case for legislation would be made very strong if progress was made in the manner he had suggested.

BRITISH EXPORT SOCIETY.

At the Annual General Meeting of the British Export Society, held on Jan. 15, Mr. F. W. GOODENOUGH, C.B.E., was elected President for the ensuing year, in succession to Lord Meston, K.C.S.I., by whom his election was moved in very cordial terms.

After expressing his appreciation of the honour which the members had conferred upon him, and emphasizing the point that he could not possibly devote much time to the work of the Society, which it was understood fell on the Chairman and Secretary, Mr. GOODENOUGH said:

Doubtless you have gone on the principle that "the onlooker sees most of the game," as the business with which I have been associated all my life—the sale of gas—is essentially a home industry. There is, of course, a considerable export trade in coke and chemical bye-products by the gas industry; but that is not the side of the business with which I am familiar. I am, however, a very close observer of the game of selling for export at the present time, in my capacity as Chairman of the Government Committee on Education for Salesmanship, of which your Chairman, Mr. Gilbert Rich, is a valued member; and from the information that is reaching me from all quarters of the world, I believe I can be of some help to the members of this Society, if they will allow me to be the channel for conveying to them some of the more important of the suggestions made by our representatives overseas.

Criticism, we know, is rarely acceptable or agreeable to the recipient. Indeed, we regard it generally as providing a very striking proof of the truth that "it is more blessed to give than to receive;" but the position, the relative position, of our export trade, by whatever standard measured—its relation to pre-war figures, or its relation to the business being secured by our competitors—is not so rosy, the employment situation in this country is not so free from anxiety, as to justify us in disregarding any competent advice given to us by experienced observers on the spot.

Through the courtesy and co-operation of my friend, Sir Edward Crowe, the Comptroller of the Department of Overseas Trade, I am in process of receiving from our Commercial Secretaries all over the world their considered views on British salesmanship abroad; and the one hopeful thought to be gathered from them is this. If we can sell seven hundred million pounds' worth of goods in the world's markets in a year by such marketing methods as we at present employ, what could we not do if our methods were all they should and might be? But this is a thought we can only afford to cherish provided we instantly set about putting our selling machine in order. For the facts are that, to an extent not pleasant to contemplate, business that we ought to be holding is going from us to our competitors, and new business that we ought to be securing is going past us to them.

Mr. Goodenough then gave quotations from the Report on the Conditions and Prospects of British Trade in India, by H.M. Senior Trade Commissioner in that country, which contained strong evidence in support of a general statement that "our marketing methods are not so scientific or carefully planned as our methods of production;" and he emphasized "the dangers of complacency, and the very great and sustained efforts which are imperatively required if we are to maintain our economic position." He added: "Increasing competition makes co-operative effort on the part of British exporters more imperative and more fruitful than ever; and the value of it has been emphasized by more than one of my overseas correspondents. I can speak from experience of the great value of co-operative propaganda and publicity in the home market, and of the constant pooling of brains and experience for mutual guidance. We have practised such co-operation in growing measure and with growing success in the gas industry for seventeen years; and I am convinced that there is great scope for it in developing British trade in the markets of the world."

Commenting on this event "The Times" Trade and Engineering Supplement says:

SALESMANSHIP IN EXPORT.

We are glad to see that Mr. F. W. Goodenough, Chairman of the Government Committee on Education for Salesmanship, has been elected President of the British Export Society. The connection between better methods of salesmanship and increased exports is so clear that it might be thought that it would be universally recognized; but the problems connected with the reduction of cost in manufacture still absorb far more attention in this country than the equally important question of reducing costs of distribution. Yet to-day in most lines there is far more scope for a reduction of price to the consumer by improved methods of distribution than by adopting new systems of manufacture. Our New York Correspondent this week has something to say on this point which is of considerable interest. In brief he shows that there is a tendency for the retail stores there to concentrate their attention on branded goods because their merits have already been advertised to the consumers and they are therefore very much easier to sell.

METROPOLITAN GAS COMPANY OF MELBOURNE.

From a Booklet prepared by the Company in Commemoration of their Jubilee.

The growth of the Metropolitan Gas Company during the past fifty years has been tremendous, and during that time it has catered for the comfort and convenience of all classes within its province. The following table shows the operations of the Company to-day, as compared with those of fifty years ago:

	1878.	1927.
Coal carbonized (tons)	62,317	362,369
Gas sold (c.ft., thousands)	499,026	4,136,881
Coke sold (tons)	17,551	186,150
Sulphate of ammonia sold (tons)	Not manufactured	3,900
Tar sold (gallons)	716,477	4,436,676
Wages and salaries paid	£51,848	£624,587
Total revenue	£215,633	£1,703,870
Total expenditure on revenue account	£157,250	£1,388,178
Capital expended on land, buildings, plant, &c.	£701,396	£3,750,466

INTRODUCTION OF GAS INTO MELBOURNE.

Some eighty-three years ago, George South, a man of ingenuity and enterprise, who carried on the business of a blacksmith in Fitzroy, adopted the idea of storing gas in air-tight containers, and offering it for sale; but his scheme, which was considered dangerous, met with little favour, and was soon forgotten. Five years later, however, gas made its first public appearance in Melbourne through the agency of an Englishman named William Overton, who, assisted by the indomitable South, lighted his shops with the new illuminant. Other business people became interested, and asked Overton to extend the new illuminant to their premises also. Though he found this impracticable, he took steps towards the establishment of a gas company. He instructed a solicitor to prepare a prospectus, and induced a number of people interested to enter into the proposal. A meeting was held on the appointed date, and a provisional committee, of which Overton was a member, was formed to further the object. As certain of the terms under which it was proposed the company should be formed were not acceptable to Overton, he objected; but as his views received no support, he recorded his protests, and left the meeting. A Company was formed with a capital of £20,000; the Rev. John Allen being the first Secretary; Overton—the prime mover in the scheme—having no place in the undertaking of which it might truly be said he was founder. The first gas-works were erected on a marshy flat between Collins Street and Little Flinders Street West; and it was from this site that gas was first supplied to a portion of the town.

An Act of Incorporation was sought from the first Legislative Council of Victoria, but was not granted, for, though the Melbourne Gas and Coke Bill passed through its preliminary stages, it was negatived on the third reading on Jan. 5, 1852. In the next session in 1853, it was, however, passed. The site for another works was subsequently secured on the Yarra Bank. The works were opened on Jan. 3, 1856. The coal was imported from Scotland, and the price charged for gas 25s. per 1000 c.ft.

The second gas undertaking—the Collingwood, Fitzroy, and District Gas and Coke Company—was promoted by the Rev. John Allen. On Aug. 22, 1860, an Act was passed incorporating the Collingwood, Fitzroy, and District Gas and Coke Company, Ltd. (the original capital of which was £50,000), providing *inter alia*, for a maximum price of 17s. 6d. per 1000 c.ft., and a maximum dividend of 25 p.ct. per annum. The South Melbourne Gas Company was subsequently incorporated by Act of Parliament; the authorized capital being £100,000.

FORMATION OF THE METROPOLITAN GAS COMPANY.

The Metropolitan Gas Company was formed by the amalgamation of the City of Melbourne Gas and Coke Company, the Collingwood, Fitzroy, and District Gas and Coke Company, and the South Melbourne Gas Company. It was incorporated by a Special Act of Parliament which came into operation on Jan. 1, 1878. The first general meeting of members of the new Company was held on Feb. 6, 1878. It is worthy of note that, except for an amendment giving the Company greater borrowing powers, the Act of 1878 stands, fifty years later, as originally passed.

In 1904, negotiations were entered into for the purchase by the Metropolitan Gas Company of the Brunswick undertaking; and the sale eventually took place on Dec. 20, 1904, the consideration being the payment of the sum of £13,250. The Brunswick Gas-Works Company Proprietary, Ltd., was incorporated in the year 1897 under the Victorian Companies Act, with a nominal capital of £50,000. On completion of the agreement for sale, manufacturing operations ceased, but the Metropolitan Company continued to use the gasholders for some little time. The original capital of the Company was £616,710, of which £557,210 was share capital, and the balance—£59,500—debenture capital.

The extension of manufacturing and distribution plant necessary from time to time to meet the increased demand for the Company's products necessitated fresh issues of shares and debentures; the Company's Act of Incorporation of 1878 giving power to raise up to £1,000,000 by issue of shares and a further amount by way of debentures. In 1920, however, Parliament authorized an increase in share capital to £1,500,000, and provided also that money could be borrowed by debentures against premium capital received on the sale of shares. The total amount of share, debenture, and premium capital in use at Dec. 31, 1927, amounted to £3,846,401.

DIRECTORS AND PRINCIPAL OFFICERS.

The first Chairman of Directors was Mr. John Benn, who held office from the inception of the Company in 1878 to the time of his death in 1895. He was succeeded by the Hon. C. J. Ham. In 1901 Mr. (now Sir) John Grice was unanimously elected Chairman. Under his guidance the Company has made great advancement. Its success has been due in a very large measure to his untiring efforts; and no survey of the history of the Company would be complete without paying a tribute of gratitude and respect to his wonderful activity and earnestness of purpose.

Upon the death of Mr. John Hinde in 1923, Mr. A. E. Bradshaw was appointed Secretary, and still holds that position. Mr. Bradshaw's experience in the gas industry is unique. He joined the Collingwood, Fitzroy, and District Gas and Coke Company in 1877 as a junior; and upon its amalgamation became a member of the staff of the present Company, occupying various clerical positions until 1888, when he was appointed Cashier. Fifteen years later he was made Accountant, and in 1913 received the additional appointment of Assistant Secretary. This dual position he occupied until April, 1923, when he was appointed Secretary.

Mr. P. C. Holmes Hunt (a member of the present Board of Directors), who had acted as Assistant to Mr. R. O. Thompson, was appointed Acting Engineer upon the latter's resignation in 1906, and Engineer in 1907. Mr. Hunt resigned his position in 1913, and was succeeded by Mr. J. N. Reeson, who is present Engineer-in-Chief and Technical Adviser. Mr. C. F. Broadhead was appointed Assistant Engineer in 1925, and subsequently Engineer, which position he now holds.

OPERATIONS OF THE COMPANY.

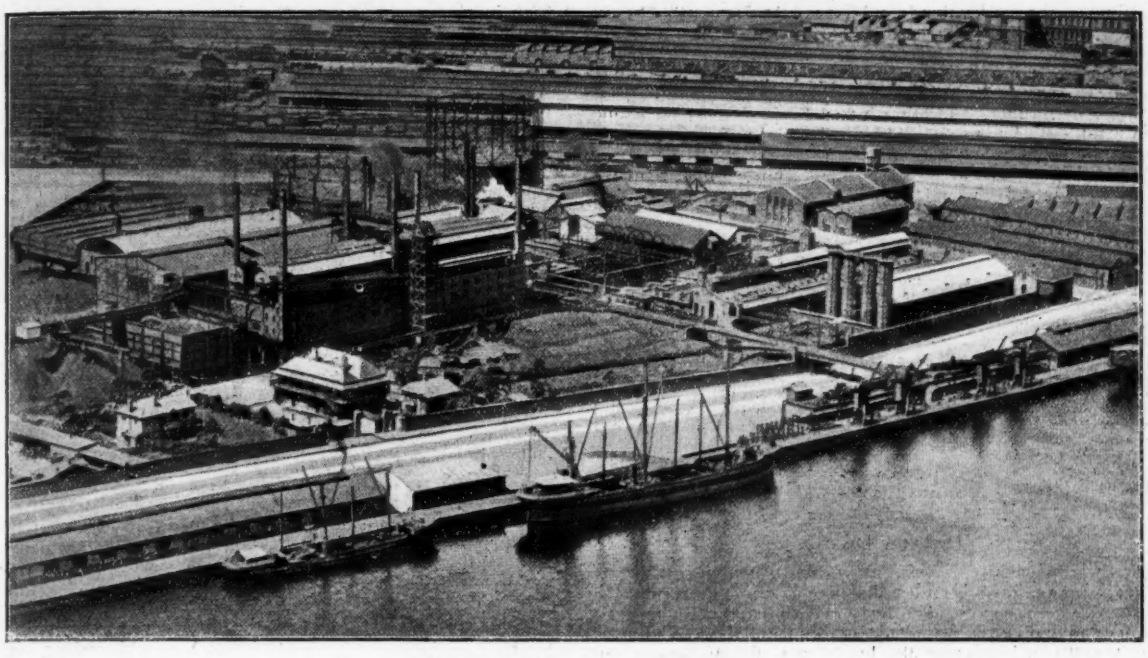
During the first year's operations of the Company, 499,026,000 c.ft. of gas were sold; the price being 7s. 6d. per 1000 c.ft. A gradual progress was experienced until 1883, after which very rapid strides were made until 1891—when the sales of gas reached 1,898,250,000 c.ft.—an increase of practically 400 p.ct. in thirteen years. This figure was the highest reached prior to the financial crisis of the 'nineties, when for some years the Company, in common with most other undertakings, experienced a serious reverse. Sales of gas fell rapidly, and in 1898 only 983,740,000 c.ft. were sold—approximately 50 p.ct. of the sales seven years before. That year, however, experienced the lowest point, and thereafter a slow but steady recovery was made. The sales of gas in 1927 were 4,136,881,000 c.ft.; representing an increase of 829 p.ct. in fifty years.

The most recent plants installed in the Company's works are at West Melbourne, and comprise the Woodall-Duckham continuous carbonization system. The carbonizing operations of the Company are still carried on at the original sites at West Melbourne and South Melbourne, though the area and capacity of the respective works have been greatly extended. Until the latter part of 1926, gas was also manufactured at Fitzroy; but owing to the high cost of carting coal to these works, together with the fact that the quantity of gas made there was under 3 p.ct. of the total produced by the Company, it was considered advisable to cease manufacturing at this station. The present plant is capable of a daily output of 19,500,000 c.ft., and the holders at the works and outstations have a storage capacity of 23½ million c.ft. The actual area over which the Company may operate is approximately 125 square miles, or 80,000 acres. Up to the end of 1927 the total length of mains was approximately 1292 miles, and the number of meters fixed on consumers' premises, including some 29,000 prepayment, was 183,461.

STOVE AND FITTINGS DEPARTMENT.

The Stove and Fittings Department of the Company was inaugurated in 1880. Free cookery demonstrations were commenced in 1902. Weekly lectures were instituted, and are still carried on. In addition, evening demonstrations have been held every season; the various suburbs being visited in turn. The attendances show how keenly the public appreciate this side of the Company's service.

The use of gas for heavy duty equipment now plays an im-



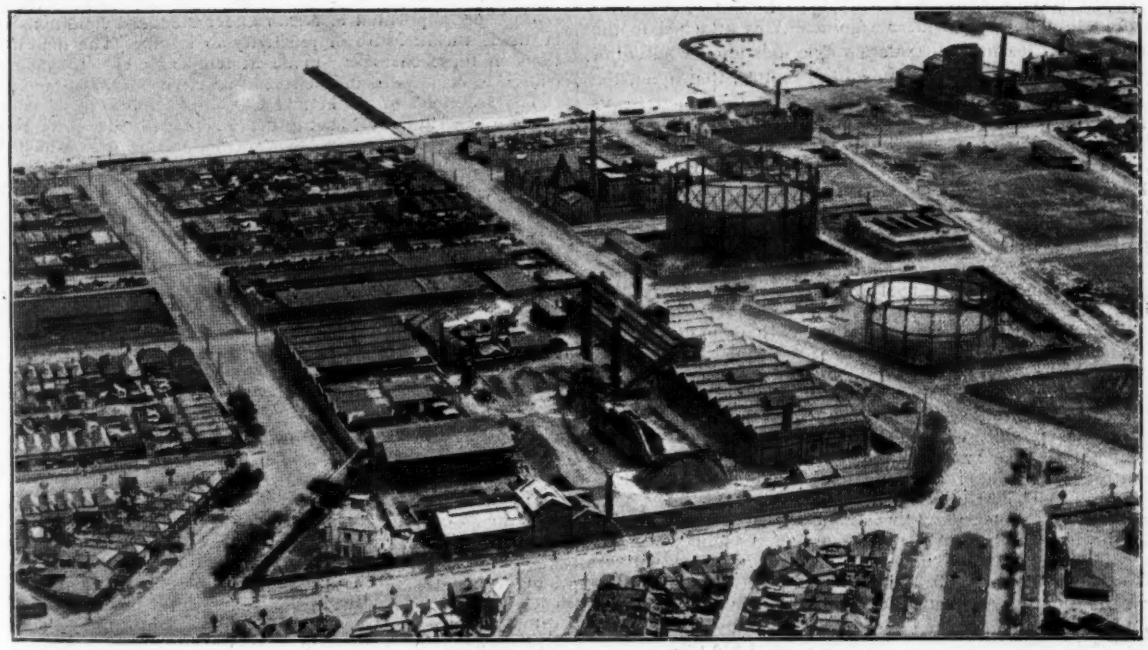
AERIAL VIEW OF THE WEST MELBOURNE WORKS.

The West Melbourne Works—the most important manufacturing station of the Company—are situated between the River Yarra and the Victoria Dock on Flinders Street Extension. These works cover an area of 17 acres, on which there is carbonizing plant with a capacity of 14½ million c.ft. of gas per day. During the year 1927, this station carbonized 255,190 tons of coal, which produced: 3,398,402,000 c.ft. of gas, 136,965 tons of coke for sale, 4,228,000 gallons of tar, 2330 tons of sulphate of ammonia, and 365,700 gallons of ammoniacal liquor. The works are equipped with washing, scrubbing, and purifying plant for treating the gas before it passes into either of the two gasholders, which have a total capacity of 2½ million c.ft. A large power station is centrally placed in the works. In addition to the usual exhausting, pumping, and other machinery essential to a modern gas plant, they contain a large pumping plant which takes the gas from the holders and sends it through the trunk mains to the other storage points of the Company's system, whence it is transferred to the distributing mains. The works contain, in addition, neutral sulphate of ammonia plant (capacity 70 tons per week), concentrated liquor plant, and well-equipped laboratories, workshops, and offices.

portant part not only in the Company's activities, but also in the business life of the community. The first large gas kitchen in Melbourne was installed at the Australian Club in 1913. Since that time over 450 installations have been effected in the city area alone. A census of Melbourne kitchens at Dec. 1, 1927, showed that of 467 establishments 456 (or 97·64 p.ct.) were using gas either exclusively or in conjunction with other fuels.

In 1913 lady demonstrators were engaged to call on new consumers, instructing them in the most economical method of using gas cookers. This free service was discontinued during the war period, but is again in operation.

The development in the use of gas for industrial purposes was slow until 1920, when special efforts were made to popularize its use in this sphere. Several gas-fired furnaces of various types



AERIAL VIEW OF THE SOUTH MELBOURNE WORKS.

The South Melbourne Works are situated at the corner of Graham and Pickles Streets on the boundary of South Melbourne and Port Melbourne, and have carbonizing plant with a capacity of 5 million c.ft. of gas per day. During the year 1927 this station carbonized 107,179 tons of coal, which produced: 1,501,344,000 c.ft. of gas, 56,376 tons of coke for sale, 1,286,107 gallons of tar, and 1431 tons of sulphate of ammonia. Like West Melbourne, these works are also equipped with the usual washing, scrubbing, and purifying plant, and have gasholder storage capacity of 4 million c.ft. A neutral sulphate of ammonia plant, capable of producing approximately 35 tons per week, is in operation, and there are laboratories, workshops, and offices. Adjacent to the works proper are located the meter and stove shops. In the former, 115 operatives and 32 improvers are employed in the repairing and testing of the large number of meters used in the Company's business; the shop being probably the largest controlled by any gas undertaking in the Southern Hemisphere. The total area occupied by works, shops, coal paddocks, gasholder, yards, &c., is 18 acres.

were imported from England, and in 1923 the Industrial Demonstration Showroom was established in order that manufacturers might test their various heat-treatment requirements, using gas as a fuel. Large numbers of manufacturers have visited this showroom to inspect the furnaces in operation, and hundreds of furnaces and other industrial appliances have since been installed. The use of gas for industrial purposes is gradually becoming established.

A comparison of the business done from the department's inception in 1880 to the end of 1903, as against the business done from 1904 to 1927, is shown hereunder.

—	24 Years 1880 to 1903 Inclusive.	24 Years 1904 to 1927 Inclusive.	Grand Total.
Total value of business done	£312,803	£2,045,621	£2,358,424
Appliances issued—			
Cooking stoves	22,071	160,014	182,085
Bath heaters	169	21,920	22,089
Coppers	..	7,704	7,704
Fires	1,967	29,770	31,737
Grillers	316	10,619	10,935
Gas irons	..	40,540	40,540
High power burners	..	4,046	4,046
Boiling burners	539	30,766	31,305
Industrial appliances	2	5,406	5,408

District Depots.

For the convenience of consumers, and to popularize the use of gas, depôts have been established in the main suburban centres. These depôts also serve as showrooms where the various gas appliances are displayed, and are the headquarters of local staffs of inspectors and fitters, who fix appliances, and generally attend to the requirements of consumers.

Construction Department.

The war was responsible for the creation of the Company's Construction Department. Faced with the impossibility of obtaining supplies of plant from overseas, contracts were sought with local manufacturers, who, however, were not inclined to undertake work of a nature so technically specialized as gas-works plant. The formation of a Construction Department was in consequence authorized, and operations commenced in August, 1918. The drawing office staff became the nucleus of the Department; the Chief Draughtsman of which was subsequently appointed Superintendent.

The workshops, which cover an area of two acres, are situated at the Company's Fitzroy Station, and are modern and well equipped. There is a construction shop 224 ft. long by 90 ft. wide; a fitting shop 88 ft. 6 in. long by 48 ft. wide, together with electricians' and pattern-makers' shops and stores; a carpenters' shop 74 ft. long by 16 ft. wide; and erection yards equipped with cranes and gantries. The manufacture and erection of much of the Company's plant, together with most of its repair work, have been carried out. Of its major engineering works, the Department has designed and built six gas-holders, two 2-million per diem vertical retort houses, a coal elevating plant, purifiers, condensers, and a very large coke handling, screening, and storage plant.

The number of employees engaged by the Company at Dec. 31, 1927, was 2207, and the amount of wages paid for the year ended 1927 was £624,587, compared with £51,848 in 1878.

Staff Superannuation Fund.

A Superannuation Fund for employees on the staff of the Company was established in October, 1926. The Company contributed the sum of £25,000 as a nucleus, with half-yearly payments of £3000 each for a period of ten years—a total of £85,000. The scheme is on a contributory basis, and is in three sections covering (1) present staff officers over 50 years of age; (2) present staff officers 50 years of age and under; and (3) future staff officers. The scale of contributions for staff officers employed at the inauguration of the scheme varies from 2·6 p.ct. of salary at 21 years of age to 5 p.ct. at 32 years of age and over. Employees appointed to the staff after the establishment of the scheme are on a scale varying from 2·6 p.ct. of salary at 21 years of age to 12·2 p.ct. at 60 years of age, according to age on appointment.

REACTIVITIES OF SOLID CARBON IN FUEL PROCESSES.

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Public Lecture under the auspices of the Institution of Chemical Engineers, in London, on Friday, Jan. 18—Sir Alexander Gibb, G.B.E., C.B. (President of the Institution), in the Chair.

In choosing this subject for a public lecture for the Institution of Chemical Engineers, I have been guided by the consideration that however wide a significance is attached to the term "public," it cannot include a single individual who is not daily and directly affected by the subject-matter, that again the control and utilization of such a property as the reactivity of solid fuel for large-scale work is one of the most important branches of chemical engineering work. That is obvious to-day, and will, I believe, be made much more obvious as developing knowledge demands modification of, or even change in, existing standard processes. My own interest in the subject provides another justification for choosing it.

The fundamental reason for the importance of the reactivity of carbon in fuel processes is that all processes for obtaining the heat of combustion of coal depend upon the gasification of the "fixed carbon" of the coal in combination with oxygen. In the simplest possible terms, we may say that the gasification is to CO_2 in such a fuel bed as that of a steam boiler, and to CO in the deep hot fuel bed of an air-blown gas producer, or in a water gas generator; hydrogen being another primary product in this last case, because the oxygen is supplied as steam.

In the gas producer, carbon monoxide is the final product desired, but CO_2 is first produced near the air entry, and the amount of CO in the producer gas is dependent on the rate of production of CO_2 to CO by hot solid carbon.

In water gas generation, the reaction is not so simple, because, having obtained water gas—mainly CO and H_2, but also containing CO_2 and undecomposed steam—even without any further direct entry of solid carbon into the chemical interaction there may be a change in composition in the gas itself, tending to an equilibrium value in the ratio $\frac{(CO)\ (H_2O)}{(CO_2)\ (H_2)}$ which rises with the temperature. The carbon, or its ash constituents, may influence the rate of attainment of this equilibrium, and so influence the result.

If in the laboratory CO_2 is passed at a fixed rate and temperature through a hot carbonized fuel such as coke, the percentage reduction of CO_2 to CO can be determined. It differs widely from one fuel to another, and can be made the measure of reactivity to CO_2. A similar determination can be made by watching the rise of pressure in a circulation apparatus as the reaction $CO_2 + C \rightarrow 2\ CO$ proceeds. Similarly, the percentage decomposition of steam under standard conditions may be made the measure of reactivity to steam. The determinations in these cases are made at temperatures and gas rates chosen to display the differences in reactivity to advantage.

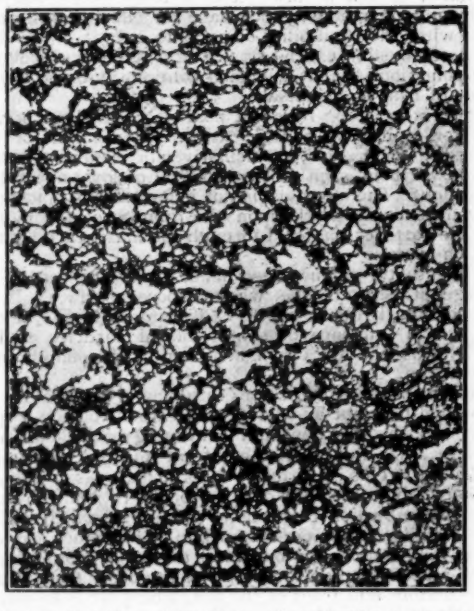
The reactions to steam and CO_2 are comparatively easy to observe experimentally, because the action in each case absorbs heat, and the temperature of the coke can be maintained constant by adjusting the amount of heat supplied by the furnace. If air is used instead of CO_2 or steam, heat is generated, and control is difficult; but it has been found possible to make the determination successfully by diluting the air with nitrogen until it contains only 2 p.ct. of oxygen, and by being a small flat surface of coke instead of a column of granulated material. In these cases, when the temperature is just a visible red, 500°-600° C., differences of the same character between one coke and another are observable with the nitrogen diluted air stream as are found using much higher temperatures with CO_2 and steam. When, however, higher temperatures such as 700° or 800° C. are used with the nitrogen-air stream, the differences between one coke and another seem to disappear. At such temperatures, the rate of reaction is not limited by the nature of the coke, but by the rate at which the oxygen reaches effective contact with it.

Hence, transferring our consideration to large-scale working, the rate of combustion to CO_2, as in burning solid fuel on the grate of a boiler furnace, or in pulverized form, can be made very high; and the rate of gasification effected in practice hangs upon the mechanical problem of effective air supply to each solid particle. But in the gas producer or water gas generator, the process of gasification is limited in rate by the necessity of gasifying carbon in comparatively slow reaction with CO_2 or steam; and the reactivity of the coke becomes a limiting factor of primary importance.

These considerations are general, but the most intense focussing of interest on the reactivity and general behaviour of carbonized fuels in recent years has a more special cause. The most direct method of abolishing the smoke nuisance, and of obtaining useful bye-products at the same time, is to subject raw coal before use to some process of carbonization. This

may be the established process of carbonization as carried out at gas-works or coke ovens, or it may be a process of rapid and partial carbonization, such as may be devised for the pre-treating of coal before use at the boilers of a power station, or for the production of solid smokeless fuel for domestic purposes.

I am not, in this lecture, concerned with the relative merits and ramifications of these processes, actual and proposed, except to point out that, if the solid carbonized fuel is to replace



Coke from Coal through 30 Mesh. (Magnification, 5 diameters.)

coal successfully in the open domestic grate, it must have the good qualities of coal, and not merely avoid the bad. If prepared casually, it will not be satisfactory. We must know more about the fundamental factors responsible for the good and bad qualities, and how they can be controlled in the processes of production. Hence the intensive study of reactivity, and the conditions determining it; reactivity being plainly involved.

Factors Determining Reactivity.

Since the gasification of a coke necessarily proceeds from the surface, the reactivity could conceivably be expressed as a product of the extent and quality of that surface. These factors in determining reactivity are important and independent, though the extent of the surface does not lend itself to separate quantitative measurement.

When a typical bituminous coal is carbonized, it melts, gives off gas, and is blown by the escaping gas into a porous spongy mass different from the original coal, which is nearly a closed solid, and quite different again from charcoal.

In the coke, the structure of the original coal has been lost by fusion, while in charcoal the original structure has been essentially retained, though fine pores and cracks have developed. The amount of surface formed as the gas escapes will vary with the degree of liquidity of the molten mass at different stages, and the rate at which gas is escaping. It will be a complex function of the two, but it seems probable that the conditions leading to the maximum development of surface will be those which lead to the formation of an expanded but uniformly fine porous mass.

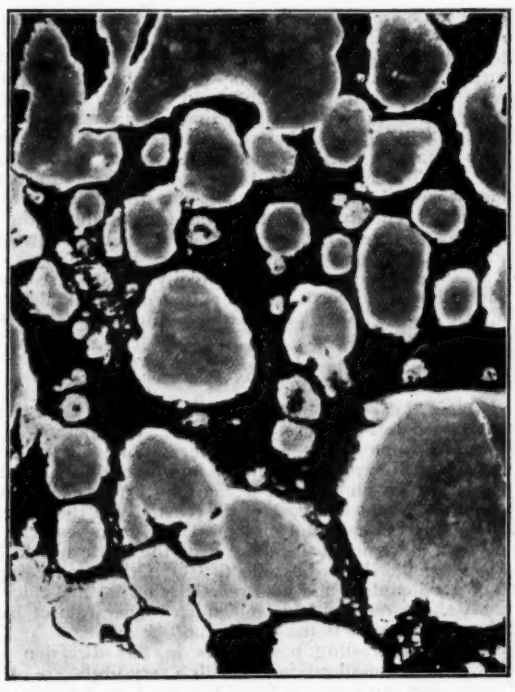
As an example, it was found that when a number of small charges of the same coal were carbonized in the laboratory in exactly the same way, except that the time of passing from 400° to 500° was increased, the reactivities to steam steadily increased also from 47 p.ct. to 59 p.ct., until the time of passage from 400° to 500° had reached 70 minutes, after which it became constant, or slowly diminished. This temperature interval was one of semi-liquidity for the coal, and there was a transition from a coarse and honeycombed to a finely porous structure as the time spent in the 400°-500° C. range increased. The diminished violence in the escape of gas, the finely porous structure, increase of surface, and increased steam decomposition in the determination of reactivity are probably directly consequential. Some large-scale results confirm this idea. The time 70 minutes seems small compared with the whole time of carbonization of the charge in a gas retort or coke oven; but this is by no means the case when the time taken by a small portion of the charge, considered separately, in passing from 400° to 500° C. comes in question.

When, in carbonizing the coal, the decomposition of the semi-fluid mass has proceeded so far towards carbon, the mass solidifies. After that, though gas is still evolved, it comes away as it would from charcoal or anthracite, without appreciable effect on the structure. There is, however, a gradual increase in true specific gravity of the solid material, and a maximum porosity is attained about 800° C. Above this temperature, there is a shrinkage of the mass as a whole, with a thickening of the cell walls and a diminution in porosity; but up to 1100° C. no further increase in specific gravity. These are the principal volume changes which occur, and will influence the reactivity of the coke, by altering the amount of surface which it exposes per unit of mass.

Temp. ° C.	Porosity. P.Ct.	True Sp. Gr.
600	54·4	1·50
800	59·3	1·81
1000	52·6	1·82

We then come to the more subtle changes brought about in various ways in the quality of the coke surface; and in considering reactivity we are compelled to concern ourselves not only with the surface of the coke exposed at the beginning of a gasification process, but that which is gradually exposed as gasification continues. Here we are brought to the structure of carbon aggregates and their reactivities.

According to the work of Sir William Bragg, and the use of his method by others, the inside of a graphite particle is an aggregate of carbon atoms, in which each of the four valencies of any one atom shares a double electron with a corresponding valency of another carbon atom, so producing a closed, interlocked, and satisfied system of great stability in both chemical and physical structure, making for hardness and chemical inertness. At the surface, however, according to this view, there are unsatisfied valencies and single electrons from the absence of corresponding carbon atoms with which to link up; and the surface is, on this account, the seat of potential chemical activity. If that is so, while retaining the same fundamental crystalline form, a continuous diminution in size of the crystal, with an accompanying increase of surface per unit of mass, would in itself account for differences in the behaviour of



Coke from Coal through 30 Mesh. (Magnification, 100 diameters.)

carbon, according to its method of crystal aggregation, to its power of holding gases physically or combining with them chemically.

It is maintained by Hofmann that he has succeeded in detecting the crystal structure of graphite in finely-divided carbon deposited from gases. Moreover, it has been recorded recently by several observers that what used to be called "methane carbon," because it was the characteristic product of the decomposition of methane at high temperatures, appearing as a glistening growth on the walls of the enclosing tube, can also be obtained by the decomposition of other hydrocarbons and at

lower temperatures. The same decomposition may give finely-divided sooty carbon in the gas, and a growth of bright methane carbon on solid surfaces in the tube. The exact conditions of formation of this bright methane or graphitic carbon are not yet known. We can take it that the transformation from smaller to larger crystalline aggregates, with a lowering of reactivity, takes place more easily at a higher than a lower temperature; but the process is influenced by the presence of solid surfaces and of foreign substances. The lower chemical stability of the surface film, its lesser rigidity of atomic structure, is probably all-important.

Returning now to changes in carbonization, and remembering that, particularly after the coke is solidified, decomposition of hydrocarbons is occurring constantly in contact with the coke, we can expect a deposition on the surface of material more graphitic and lower in reactivity than that of the coke as a whole. This has been demonstrated by numerous experiments. Laboratory carbonizations, conducted in a stream of nitrogen or hydrogen, have given cokes of considerably higher activity than exactly similar carbonizations without the gas stream. The treatment of cokes with methane or ethylene at temperatures which decomposed these gases have been found to give a great lowering of reactivity. The reactivity of black pieces of coke after a partial gasification has been found to be much higher than that of the grey silvery coke.

At the same time, we must not lose sight of the fact that low-temperature decomposition of hydrocarbons or other volatile substances may give rise to the presence of a form of carbon, permeating the mass, of much smaller crystalline aggregates, much more approaching the amorphous, than the great mass of the carbon formed from complicated ulmin residues.

It will be understood, however, from what has gone before, that the formation of a comparatively unreactive carbon can occur in the coke without the intervention and decomposition of hydrocarbon gases as a direct result of the instability of the above structure in the surface layer. This makes any method of determining reactivity unreliable in which the rate of gasification is slow. The results obtained at any period of any experiment will depend upon whether the gasification has been sufficient in amount not only to remove the initial film, but also to outstrip the gradual formation of less reactive material proceeding from the surface inwards.

Inorganic Constituents.

Numerous quantitative observations have demonstrated clearly in recent years that additions of small percentages of some oxides, such as soda, lime, and oxide of iron increase the reactivity of coke both to steam and carbon dioxide in a marked degree. This effect is not due to an increase in the amount of surface, though that does sometimes occur when the oxides are mixed with the coal before carbonization. The enhancement is obtained when the addition is made in the form of soluble salts by impregnation of a " pure " coke after carbonization, whereby any effect from altering the amount of surface is excluded. The explanation of the magnitude of the effect is under observation, but the results obtained, though suggestive, are not ripe for publication.

In the case of sodium carbonate additions, there seems to be no doubt that the carbon itself is obtained in a highly reactive form, not easily changed on heating. But that is not the explanation in other cases.

Bearing on Practice.

It is plain, for reasons already explained, that the reactivity, as determined in the laboratory by some such method as those described above, conveys useful information; but in practice its significance may be difficult to interpret, or its effect may be obscured. In illustration, let us take a few examples. In the gas producer the influence of the reactivity of the descending coke column is simple and direct. The CO_2 necessarily generated while air is in excess quite near the grate has to be reduced as completely as possible to CO if the producer gas is to be of good quality, and here reactivity of the fuel comes into play. A shallower fuel bed or a much higher rate of blowing may become possible if the fuel is more reactive.

There are interesting possibilities in this direction at the present time for small producers with a very high rate of working generating producer gas for the internal combustion engines used in motor transport, since the size and weight of the gas generator can be cut down. Charcoal is being tried, and the special cokes with inorganic additions may well prove useful. Again, the possibilities of completely gasifying solid fuel in an oxygen-steam blown producer, making a gas without the heavy dilution of inert nitrogen, which is now the heaviest handicap of producer gas for distribution purposes, are so fascinating that no avenue to possible success should be left unexplored. This subject has been discussed before the Institution of Gas Engineers, and also presented to you in a paper by Mr. Finlayson. The reasoned opinion of Mr. Finlayson was against the process for immediate application, but the large output per unit of plant which might be obtainable with an oxygen steam blast and a highly reactive coke would go some way towards removing the economic bar. Technical difficulties would have to be surmounted, but I think these would succumb to skilful design. In the domestic open fire, the behaviour of solid carbonized fuels has received attention from Dr. Margaret Fishenden, and has been the subject of special study at Leeds by Mr. Hodsman and collaborators. The influence of reactivity there is somewhat peculiar. In the first place, it is so far complicated by other properties. So much depends upon the rate at which any fresh charge of carbonized fuel can be brought into active combustion throughout the mass, or can be brought to a temperature where it can ignite and its reactivity be made an effective influence. To begin with, the ignitibility comes into question—the ease with which combustion can be started at a number of points under such conditions that it will then continue without any further supply of heat from outside.

There is only the roughest possible parallelism between results for ignitibility and reactivity. The reason for this can be readily understood, particularly when one considers semi-carbonized fuels, such as the products of low-temperature carbonization. The structure is not homogeneous, and the ignitibility depends so much upon the number of the more easily ignitible particles scattered through the mass, each acting as an ignition centre.

In reactivity, on the other hand, we are concerned with an average property of the whole exposed surface. It will be realized that, if the reactivity is determined in CO_2 and steam, the general influence of some isolated particles of high reactivity would in any case be checked by the endothermicity of the reaction.

Another factor which comes into play is the heating through of the fuel bed, not by oxidation of carbon, but by a spreading of heat in the gas flames, the burning of residual hydrocarbons, &c., expelled on heating from any particles imperfectly carbonized. This is, perhaps, the principal reason why a charge of completely carbonized coke is longer in being brought into effective combustion than one of a material which will give up some volatile matter on combustion. Too much exposed surface is dull, with a low output of radiation. One direct effect of the reactivity proper may be mentioned. CO_2 is produced at the bottom and front of the fire, where air is in excess; and if the fuel is not reactive, it passes through the fire with little alteration. But if the fuel is reactive, it suffers much more reduction to carbon monoxide, which burns as a gas flame from the top of the fire. To the extent that this reduction of CO_2 takes place, the interior of the fire is cooler, as a direct result of using more reactive fuel. Moreover, the radiant efficiency of the gas flame burning above the fire is much lower than that of a solid fire, or of a gas flame heating an immersed solid, as in an ordinary gas fire; and a lower percentage of the heat generated by combustion is radiated into the room. Hence the peculiar effect obtainable from a coke treated with sodium carbonate, so as to increase its reactivity. There is a longer flame burning from the top of the fire on account of the large CO_2 reduction, and a lower radiant efficiency from this fire than would come from a comparatively flameless fire of gas coke.

Another rather complicated example is found in the water gas process, with its alternation of blowing with air in order to store heat in the fuel bed, and running with steam for the making of water gas. In the air blow, the primary object is to store sensible heat in the coke bed by burning some of the carbon. If the coke is reactive, CO_2 is reduced to CO. Less heat, therefore, is stored in the fuel bed, and more goes away as producer gas. The unreactive coke is, therefore, better for this stage of the process. When, however, steam is turned on for the " run," making water gas, it is the more reactive coke which is better able to effect its decomposition, and so allow of a high rate of working, without the escape of too much undecomposed steam.

In addition to the aforementioned effects from reactivity there is a possible complication arising from the peculiar nature of the water gas process apart altogether from the reactions of gasification. The solid fuel itself functions like the brickwork of a regenerator, in that it is used as a medium for storing heat during the air " blow," which is given out in the steam " run." The permissible rate of working, and length of time during which the air or steam blow should be continued, are then partially dependent upon the rate at which the pieces of coke can be heated up or cooled down from the outside, upon passage of heat by conduction, radiation, or convection into or out of the porous solid fuel. On this factor, there is very little quantitative information.

Apart from these considerations, which are inherent in the nature of the water gas process, others arise in the more modern forms of the plant where a use, more or less efficient, is made of the potential and sensible heat leaving the generator during the air blow for the raising of steam, so lessening the loss which has been referred to as arising from the reduction of CO_2 to CO. It is not strange, then, that quite different opinions are held and expressed as to whether an unreactive or reactive coke is, on the whole, better for water gas manufacture. The answer would probably not be the same for different designs of plant. Even to get a satisfactory answer for one plant would require careful and rather tedious experiment. It would not be

sufficient to compare the two cokes, using the same cycle of operations in each case—that is, the same succession of time periods for blowing with air and steam. It will be readily understood that what is calculated to give the best results for one coke might be quite unsuitable for the other. In order to make a fair comparison, it would be necessary to determine by experiment the optimum conditions, the right cycle for each coke, and to make the comparison on that basis, bearing in mind, moreover, that the verdict might be different according to the importance attached to the thermal efficiency pure and simple, and to that combination of thermal efficiency with rate of output, which comes nearer to a figure of merit for practical working.

I am afraid that the picture I have presented of reactivities and their cause and consequences must appear somewhat confused. Moreover, I am conscious that in dealing with the causes and nature of reactivity I have had to put some views forward without dealing with the experimental evidence upon which they are based. It was necessary, however, to do that, if I were not to lose myself in detail. Perhaps what I have said will explain to some extent what you can see on surveying the field of experimental work on this subject. Some of it is being directed to laboratory studies of a kind which may be described as purely scientific, or even stigmatized as academic. It may seem strange to say, at this period of the world's history, that in the commonest of all chemical reactions in the use of fuel—the gasification of carbon—there is so much left to investigate; but that is the simple truth. It is partly because we know really so little about the fundamental facts that, in order to make immediate progress in the preparation of solid smokeless fuels with desirable properties, so much experimental work of another kind is called for—work which depends upon large-scale trials, leading to conclusions which can be applied successfully in limited ranges. There is room for both types of work.

A similar diversity may be seen in the laboratory tests which are now being applied to coke. On the one hand, we have such a determination as that of the reactivity to CO_2 dependent upon a single reaction with a specified temperature and rate of gas flow. On the other hand, various tests have been designed in which the behaviour of a fuel is studied in actual fires and small gas producers, imitating the behaviour of particular appliances or groups of appliances, not testing a single reaction or a single quality, but a group of qualities desirable for certain uses. The diversity arises from the present necessities of the case.

MIDLAND JUNIOR GAS ASSOCIATION.

Working Life of Retort-Settings.

A Meeting of the Association was held on Jan. 17 at the Council House, Birmingham—Mr. F. CAUDWELL, of the Shrewsbury Gas Light Company, presiding.

The Hon. SECRETARY (Mr. H. C. Wells) was instructed to write to Mr. L. W. Hathaway, of Wolverhampton, who had met with an accident, expressing the wishes of the members for his speedy recovery.

THE WORKING LIFE OF RETORT SETTINGS: SEVEN YEARS' EXPERIENCE WITH DEMPSTER-TOOGOOD CONTINUOUS VERTICALS.

By R. L. GREAVES, Senior Chemist and Technical Assistant to the Shrewsbury Gas Light Company.

In April, 1921, three beds, each of four retorts, 23 ft. 6 in. over the brickwork, were installed at Shrewsbury. The refractory used was Allen's siliceous material. This installation was visited by our Association on Nov. 3, 1928, and will be referred to frequently.

In all realms, deterioration is an important feature, requiring consideration when a purchase is made; and the real value of the thing purchased always depends on how long it will function efficiently. The fact that it will deteriorate is certain, and in itself is no detriment, provided that the time factor is reasonable. This, of course, applies to retort settings, and a setting cannot be condemned for wearing out, but it can be condemned for wearing out too soon.

The working life of a retort setting, among other things, depends upon:

(1) The materials used.
(2) The design, foundations, and building of the setting.
(3) The starting-up process.
(4) The working methods and conditions.

For long life, fireclay and silica materials must have certain qualities.

(1) They must possess refractoriness, and resist any temperature they are likely to meet.
(2) They must resist rapid fluctuations in temperature, and must not crumble or crack on being let down.
(3) The crushing strength must be such as to withstand working loads at working temperatures, and the materials must resist any strain likely to arise under working conditions.
(4) An essential quality is resistance to the chemical action of dust or atmosphere.
(5) Expansion or shrinkage on firing the setting are both undesirable, and should be as small as possible.

These requirements apply equally to a good jointing material. Time will not allow further consideration of these qualities, but many points illustrating them will arise later. It is important to note that refractoriness under load is much more important than fusing temperature, and has not in the past received the attention its importance warrants. Porosity increases resistance to temperature fluctuations, but reduces the strength of a material, and increases liability to chemical attack.

JOINTING MATERIAL.

Jointing material is usually supplied by the manufacturers of the particular refractories. It may in several ways be responsible for an inefficient working life or failure of a setting.

(1) Badly filled joints will increase the leakage of coal gas from the retorts, and may produce short circuiting in the flues.
(2) They may allow leakage of producer gas to positions of the setting where it has no right, and thus cause local heating.
(3) Settlement of the higher portions of the brickwork may take place when joints in the lower portions fail, or run.
(4) Jointing material of inferior refractory index not only fluxes easily itself, but reduces the ability of the blocks with which it is in contact to stand up to working temperatures, setting up running of the block at the joint.
(5) If a jointing material lacks adhesive properties, it may be pressed out from between the blocks by expansion, or crumble away, leaving open joints.

The more nearly a jointing material approaches in chemical composition and physical behaviour to that of the bricks with which it is used, the more satisfactory are the results obtained. A joint when fired should be as sound as the blocks themselves. That this was the case with our vertical setting is indicated by a representative specimen of silica jointing material taken from the combustion chamber on dismantling. Crushed silica is used for jointing silica bricks. A mixture of raw clay and grog is used for fireclay bricks. Since the softening temperature of silica-fireclay mixtures is lower than that of either constituent, hitherto a very small quantity of selected high-class fireclay has been used in jointing for silica, the idea being to improve the adhesion of the material; but it is open to question whether the "medicine is not worse than the disease."

The method of manufacture of moulded horizontal retorts has a bearing upon our subject, as it has been stated that hand-made retorts have a longer life than machine-made; but this is open to question. General experience shows that segmental horizontals work longer than moulded retorts. Small tongued and grooved segmental retorts, owing to their flexibility, will work for five years without repairs, which, when required, are the more easily performed. It has been pointed out, however, that the usual way of expressing the life of a retort in terms of the number of days it has been at work is misleading, unless, in addition, the quantity of coal carbonized, the working temperature and the therms of gas produced by the retort are given.

As an example of a reasonable working life for silica segmentals, figures (recently published) referring to Beckton stated that a life of 2000 days was hoped for—this with the carbonization of 3400 tons per 20 ft. retort, and 4000 tons per 23 ft. retort.

FOUNDATIONS AND CONSTRUCTION.

The need for adequate and stable foundations is obvious. The loads on vertical setting foundations are often as much as 2 tons per sq. ft. Foundations for a Dempster-Toogood setting of 3 beds, which have proved capable of the required performance at Shrewsbury, were calculated to a base load of 1 ton per sq. ft.

Proper supervision during the construction of a setting is essential to secure a long working life. Careless building can destroy the result of much forethought in securing good materials and correct design. Blocks and bricks should be examined for cracks or faults as they are delivered at the works,

and again as they are being laid. They are seldom geometrically exact, and the worst in this respect should be rubbed down to give a true joint, or discarded. Joints should not exceed ¼ in., and tongued and grooved joints are best with little more than a wash of suitable jointing. The importance of accurately fitting the joints can hardly be over-emphasized; and were it not for the very high cost, the grinding of all joint faces would be advisable. With vertical retorts it is essential that "bellying" be avoided as regards the retort faces. The retort blocks must be laid accurately, and must be properly tied in. Special precautions are necessary during building to make the proper expansion allowances.

STARTING-UP AND WORKING.

The third responsibility rests with the gas undertaking and those in charge of the starting-up and continuous working of the setting. To a large degree the working life depends upon (*a*) the drying out, and (*b*) bringing the setting to a working temperature, and the avoidance of cracks by too rapid and uneven drying, or explosions when going on to gaseous firing. Vents must be allowed for air in the retorts as it is heated and expanded, so that it shall not force itself through weak joints. Tie rods must be watched, and slackened if necessary. These may be provided with lead rings.

When a silica brick (previously fired to Cone 14—1410° C.) is heated, a regular thermal expansion takes place up to 200° C. From 200° to 250° C. an extremely rapid expansion occurs, the increase in volume amounting to 0·75 p.ct. of the original volume. This, then, is a critical range in the raising of heats, and should be passed very slowly. Regular expansion takes place through the range up to 560° C. At about 575° C. there is a sudden expansion owing to the transition from α quartz to β quartz. It is in these warming-up stages before red heat that up to 75 p.ct. of the total expansion of a properly fired silica brick takes place; and this thermal expansion is, of course, reversible. The total expansion of such a brick is about 1·7 p.ct. The permanent expansion should have been reduced to not more than 0·2 p.ct. in manufacture.

Obviously the bearing this has on the life of a retort is that, unless due care is taken to minimize expansion, to allow for that which cannot be obviated, and to pass the critical ranges of temperature slowly when heating-up or letting down, retorts and flues may be seriously deformed, and strains incurred which will crack or shatter the refractories.

On reflection, it will be clear that at any moment of the six weeks' period for drying the setting and raising it to red heat, there will be some of the 75,000 bricks (or their equivalent), which constitute a setting, passing that critical temperature of almost sudden expansion, so much so, that the only safe method is one of slow but sure progression of the accumulation of heat throughout the six weeks. That this is the case is emphasized by the fact that, while definite critical temperatures of expansion are known for each of the α and β modifications of the three distinct crystalline forms of quartz (the relative proportions of which vary in different bricks as they leave the kiln), the actual critical temperatures of the brick within the setting will also vary from many causes, such as the load on the brick and the proportion of the area facing the flue through which the heat must penetrate, and the steam find exit.

CONTINUOUS WORKING.

When a setting has been brought to a working temperature with the caution already indicated, care must be taken to keep this temperature within prescribed limits.

Practical limits of refractoriness are:

Silica material,	1450° C. ..	Margin of safety, 150° C.
Siliceous ,,	1350° C. ..	Margin of safety, 80° C.
Fireclay ,,	1250° C. ..	Margin of safety, 100° C.

A pyrometer must not be relied upon implicitly. It must be standardized frequently; neither must one's powers of judging heats be over-estimated. Rapid fluctuations of temperature are very destructive, and must be avoided.

The Dempster-Toogood vertical setting has steel joist supports at the bottom, and these must not be over-heated. They are cooled by air tubes, but must be watched, and if any sign of redness becomes apparent in the tube, a slight reduction in the temperature of the waste heat flues or increased steam to the retorts at the nozzles will cool them. If the charge in a vertical retort hangs up, and causes a leakage of coal gas into the heating flues, over-heating needs to be guarded against. The steady draught on the setting maintained by a waste-heat boiler, turbine, and fan leads to even heats, decreased liability to overheating and fluctuations of temperature, as compared with a variable chimney draught, and therefore reduces the possibility of damaging the refractories.

Insulating material may become a snare, and lead to a falling off in heat, owing to the development of hidden cracks in the wall behind the porous insulating walls. Air leakage of this nature needs to be prevented by removing the insulating bricks at reasonable intervals, and pointing the wall behind them. Every possible source of air leakage should be examined before removing them, however, as they are very expensive, and very friable, and will not withstand frequent removal.

Dust should not be allowed to accumulate in the heating flues, particularly in that if it is inadvertently heated above its fluxing point it is difficult to remove without damaging the refractories, and clean flues are essential if good heats are to be maintained.

Scurfing the retorts is a process which needs great care, particularly with silica material, or the efficient working life may seriously be impaired. When a retort is to be emptied, the control damper requires checking to avoid over-heating. Silica has a tendency to spall, and scurfing conditions would seem to favour spalling. In a vertical retort a smooth surface is essential to proper travel of the coal, and a rough spalled surface prevents it. When the carbon is burning off the face of a vertical retort, the temperature is necessarily higher on the retort face than when the retort is working, even if the combustion chamber is reduced below working heat. The rate of combustion of the scurf is regulated by the size of an orifice in a plate on the bottom receptacle, by which the upward current of air is controlled. The combustion of the scurf must not be so fierce as to over-heat the retort face, as this undoubtedly causes spalling. However, if the carbon is to be burnt off in reasonable time, a high surface temperature cannot be avoided. At about 1470° C. and upwards, tridymite is converted into cristobalite, and a fluctuating temperature at this range should be avoided.

Silica retorts are found to require more frequent scurfing than siliceous ones. The scurf seems to fall away from the silica material more easily, and obstructs the coal travel. Our siliceous retorts need scurfing every six or seven weeks, and the silica retorts every four or five weeks. Apart from the fact that the more often a retort needs scurfing, the shorter its life will be, the carbonizing capacity of the silica retorts is reduced by this frequent scurfing; but the efficiency of the retort is increased while it is at work.

WORKING REPAIRS.

Working repairs to leaky retorts are often possible, and their life is extended thereby; but careless use of unsuitable patching material may do more harm than good, and damage the refractories by lowering their melting point. When a vertical retort is empty for scurfing, leaky joints may be detected by putting a temporary pressure on the combustion chambers, when the producer gas will burn in the retort at the leaks. These can be made good with suitable jointing material.

OBSERVATIONS DURING THE DISMANTLING FOR RE-BUILDING OF NO. 3 BED, COMMENCED APRIL 7, 1928.

As will be se from the particulars regarding repairs, at the time of disman ing this bed consisted of 3 siliceous vertical retorts, which had been in operation since April, 1921, and one composite retort (No. 10), having a 5 ft. 6 in. belt of silica in the combustion zone, which had worked since summer, 1925. The latter retort was quite sound, but rough on the inner silica face from spalling. It was not demanding repair, but had to be taken out, as being the only convenient way of dealing with the other and older retorts.

CONDITION OF SILICEOUS RETORTS.

These were thin in places, and badly pitted in others (chiefly just below the burners); rough on the retort face, and there were signs of local heating in No. 9 retort. The lower portions of all the retorts, after 7 years' working, were in a workable condition, and looked good for years of service. The brickwork at the extreme bottom of the retort was worn and broken in places near the ironwork; but this is a position easily repaired from the extractor tray. The burners were smooth at the top and rough at the bottom where the producer gas meets the secondary air.

CONDITION OF NO. 10 RETORT (5 FT. 6 IN. BELT OF SILICA).

The combustion chambers were as good as new, and the silica bricks and jointing material were in perfect condition.

The silica retort blocks were perfect on the combustion chamber side, but on the retort face spalling had taken place in the case of those blocks situated immediately below the burners to a depth of 2 or 3 ft. therefrom. This is the point of maximum combustion, as the producer gas burns downward. The lower portion of the Oughtibridge silica and the Allen's siliceous material was good throughout. The unscathed condition of the combustion chamber face of the spalled silica blocks showed that over-heating had not occurred, but that the material was incapable of withstanding, unharmed, the prevailing retort atmosphere and conditions in the immediate vicinity of the burners —*i.e.*, the zone between 5 ft. to 8 ft. below the top ironwork. The condition of the ironwork will be dealt with later.

The spalling referred to above demands special consideration, because it is one of two important factors to be taken into account when deciding whether to instal silica or siliceous verticals. The other factor is one already dealt with—namely, that silica retorts are found to need scurfing more often than siliceous ones. Though these are two disadvantages of silica, they are practically the only genuine ones, and by no means outweigh the advantages. This is particularly the case when one considers that it may be possible to locate the cause of spalling, and prevent it altogether. The effect of a spalled surface is to impede the downward travel of the coal. When a retort is freshly scurfed, and the surface freed from carbon, the interference caused by roughness is at a maximum. When the

retort has worked two or three days the rough surface is covered with a smooth thin layer of carbon, and the travel becomes normal and poking is easier.

Our experience indicates that the life of good silica material in the heating flues and combustion chambers is of great duration, and this also applies in the retort for positions 4 ft. below the burners—*i.e.*, 9 ft. below the top of the brickwork, and downwards; but apparently the same material cannot be expected to withstand the working conditions in the retort above this level without some spalling.

The possibility of damage to the face of a silica retort by the poking rods cannot be overlooked. The spalling certainly takes place in the position most subject to rodding; but as this likewise is the zone of critical temperature and critical chemical formation, as the descending coal yields its vapours at 900° C., it is problematical whether the bars, if carefully and properly used, create much of the damage. When the retort is working, the highest temperature inside is well below the position where most spalling occurs. When the retort is being scurfed, however, this is the hottest zone, as there is no moving coal to cool it.

Summarizing, the position where spalling occurs is subject to

(1) Maximum corrosion.
(2) Greatest liability to damage by poking.
(3) Highest temperature at scurfing time—*i.e.*, highest temperature ever attained by the interior retort face.

The silica retorts installed during May and June, 1928, were put into commission in July. The indication so far is that they will give an improved performance as compared with the silica retorts installed previously. No. 9 retort spalled a little the first time it was scurfed, but has not done so appreciably at any subsequent scurfing. The other new retorts have not spalled at all as yet. Spalling is still taking place on occasions with the older silica retorts. The new silica retorts need scurfing every six weeks. This is a week longer working than the earlier ones, and may be due to the different section.

Steaming.

The practice of steaming the charge would appear at first sight to be likely to have deleterious effects on the refractories; but in our case there is no experience of any such thing, except in the immediate vicinity of the coke receptacle. Only the bottom 1 ft. of brickwork is affected, and is easily repaired from the extractor tray.

The Life of the Iron-Work ("Dempster-Toogood" Continuous Verticals).

The principal bench iron-work consists of the bottom coke receptacles, the iron tray and extractor gear, and, on the charging stage, the coal bins and valves, the off-take pipes and boxes. The setting is supported by stanchions and horizontal steel joists. The coke receptacles are subject to very strenuous conditions—abrasion by coke and attack by condensed steam. The working parts of the extractor gear are subject to coke dust, which is in evidence during discharging. Extensive patching of the receptacles has been necessary in many cases.

Observations on the Condition of the Iron-Work During the Dismantling of No. 3 Bed, June, 1928.

This iron-work has been in use seven years. The middle sections of the coke receptacles were in the worst condition and badly corroded. Grooves were worn in the sides of the iron-work evidently caused by the friction of the coke between the tray and the wall. The cast iron trays were in good condition, also the balls. Some of the guides were badly wasted, and in some cases the balls had rotated on the guides, and cut into them instead of running with the tray. The joists supporting the setting brickwork, and to which the receptacles were attached, were unharmed. The off-take boxes and pipes were set aside for cleaning and use in the new setting, as were also the coal bins and valves. The bins needed decarbonizing, and the valves refacing. The life of the firebars is 3 years, and the producer linings 2 years.

The following are results obtained over seven years with three beds of "Dempster-Toogood" continuous verticals at Shrewsbury, and details of repairs performed which I am able to submit by kind permission of my Chief, Mr. C. M. D. Belton. The chemical analysis and physical properties of the refractories used in the setting are appended.

Results obtained over Seven Years with 3 Beds of "Dempster-Toogood" Continuous Verticals at Shrewsbury (12 Retorts).

Total gas made (April, 1921, to June 30, 1928), 1,616,492,500 c.ft.

Total coal carbonized	=	92,011 tons
Gas made per ton	=	17,568 c.ft. (C.V. 457·4)
Therms per ton	=	80·366

July 1, 1921, to June 30, 1928.

Total gas made	=	1,590,305,700 c.ft.
Coal carbonized	=	90,238 tons
Gas made per ton	=	17,623 c.ft. (C.V. 457·4)
Therms per ton	=	80·6076

April, 1921, to June 30, 1928.

Average working days per retort	2079
Average number of days scurfing per retort	104
Average number of days disuse (repairs, &c.)	445
	2628

Average Record per Retort (8 of the original retorts still working satisfactorily).

Actual work	=	2,079 days per retort
Gas made	=	134,707,708 c.ft. (457·4 B.Th.U.)
Coal carbonized	=	7,520 tons per retort
Steam gasified	=	1,128 tons per retort (15 p.ct. steaming)
Gas made per retort per day	=	64,751 c.ft.
Throughput per retort per day	=	3·7 tons
Gas made (12 retorts) per day	=	777,012 c.ft.

Average working temperature: Siliceous retorts . . 1350° C.
Silica retorts . . . 1390° C.

Guarantees Given with Plant (which have throughout the 7 years been regularly exceeded).

Gas made per retort per day	62,500 c.ft.
Gas made (12 retorts) ,,	750,000 c.ft.

Working Results. Dempster-Toogood Verticals, Shrewsbury.

Date.	Make Per Ton. C.Ft.	Therms Per Ton.
March 1 to June 30, 1922	18,000	81·612
March 1 to May 31, 1923	18,513	83·771
May, 1927	18,717	85·911
July, 1928	18,118	83·071
July, 1921, to June, 1928	17,623	80·608

Repairs to Vertical Retorts.

(Gas-making commenced April, 1921.)

Original material installed, Morton's "C.O." and Allen's siliceous material.

Repairs—Summer, 1923. Materials used, Allen's chamotte.
Top 4 ft. of 8 retorts. (Nos. 1, 2, 5, 7, 8, 9, 11, and 12.)
Top 5 ft. of 4 retorts. (Nos. 3, 4, 6, and 10.)

Summer, 1925.
Retorts Nos. 4, 6, 8, and 10.
Top 5 ft. with Allen's chamotte.
Next 5 ft. 6 in. with Oughtibridge 95 p.ct. silica.

Summer, 1928.
No. 3 bed. (Retorts Nos. 9, 10, 11, 12.)
Bed re-built complete.
Top 4 ft. 6 in., Allen's chamotte.
Next 6 ft., Oughtibridge silica.
Next 13 ft., Morton's "C.O." material.

Refractory Materials.

Oughtibridge Silica.—

Silica	94·98 p.ct.
Titanic oxide	0·19 ,,
Alumina	1·28 ,,
Ferric oxide	0·50 ,,
Manganese oxide	N.D.
Magnesia	0·10 p.ct.
Lime	1·60 ,,
Potash	0·36 ,,
Soda	0·82 ,,
Loss when calcined over 109° C.	0·22 ,,
	100·05 p.ct.

Refractory test. Cone 31—
1690° C.
3074° C.

Refractory test under load (50 lbs. per sq. in.) Cones 30 to 31—
1670° C. 1690° C.
3038° C. 3074° C.

After expansion test. Pieces fired at 1500° C. (disappearing-filament optical pyrometer used) for 2 hours—
After-expansion = 0·30 p.ct.
Sample dried at 109° to 110° C.
Percentage porosity, 24·52.

Morton's CO material (siliceous).—

Silica	84·52
Alumina	13·39
Oxide of iron	1·16
Lime	0·39
Magnesia	0·11
Alkalies	0·43
	100·00

Refractory test. Cone 27—
1610° C. 2930° Fahr.

Refractory test (under load of 50 lbs. per sq. in.) Cone 17—
1480° C. 2696° Fahr.

Coefficient of thermal expansion (between 15° C. and 1250° C.)—
0·000007

Allen's Chamotte High Alumina Material.—

Silica	53·46
Alumina	41·30
Iron	2·78
Titanic oxide	0·19
Lime	0·25
Magnesia	0·73
Potash	0·68
Soda	0·50
Loss when calcined	0·11

In conclusion, our experience indicates that the life of vertical retorts is certainly as long as that of horizontals. Comparing

the two systems it is safe to say that a working life of 2000 days may be secured in either case, but that whereas in this period a 23 ft. horizontal retort will carbonize 4000 tons of coal, in the same period a continuous vertical retort, working with a throughput of 3·7 tons per diem., will carbonize 7400 tons of coal, and gasify 1110 tons of steam (15 p.ct. steaming).

The disadvantage of using an aluminous material is that it has usually a large after-contraction. The advantages are that it is mechanically strong, and has a very high melting point. By special method of manufacture the disadvantage of after-contraction has been overcome in this chamotte material.

Discussion.

The CHAIRMAN commented upon the great improvements which had taken place in the construction of carbonizing plant during the last twenty years. He supposed it would be correct to say that then little was known of siliceous material or silica: but the demand for increased make and the higher temperature that was necessary to effect this had necessitated the use of a different class of refractory material. As to the material employed, a vast amount of research had been done by the Institution of Gas Engineers, but it was not often that they had an opportunity of listening to a paper on the subject, and of seeing examples of the behaviour of the material after being in actual use. The need for good workmanship was essential.

Mr. C. M. D. BELTON (Shrewsbury) said that many useful points had been brought forward by the author.

Mr. F. J. BENGOUGH (Nechells Works, Birmingham) inquired how the repair work in the retorts was carried out, particularly in regard to spraying. He also discussed the question of scurfing, and of leakages in the lower part of the retorts.

Mr. GREAVES replied that scurfing was apparently the most critical time in regard to spalling. The use of a mop with a prepared jointing compound was effective in retort repair work. He had used a cement jointing compound, but cement should be applied with great caution; and it was well first to ascertain what its behaviour had been elsewhere.

Answering questions, the author stated that at Shrewsbury they had actually steamed up to 25 p.ct.; but it should be borne in mind that efficiency fell as steaming increased.

Mr. S. J. D. WILLIAMS (Stourbridge) stated that they had retorts which were lined almost entirely with silica; and there were others having 10 ft. of silica at the top end only. They were able to work longer with the latter retorts; but with the all-silica retorts they were able to resume work more quickly after scurfing.

VOTE OF THANKS.

Mr. A. R. MYHILL (Vice-President), in moving a vote of thanks to the author, observed that external devices were now being proposed for the removal of dust. The question of determining leakages in the lower part of the retorts was a most important one.

The resolution was seconded by Mr. W. MACNAUGHTON (Wolverhampton), who pointed out that a greater throughput was to be expected by the use of silica, as compared with other materials, and the thermal yield should also be good.

The resolution was carried, and Mr. GREAVES briefly replied.

WALES AND MONMOUTHSHIRE JUNIOR GAS ASSOCIATION.

Visit to Messrs. Lysaghts' Steel Works.

On Saturday, Jan. 5, members of this Association met at Newport for the fourth meeting of the session. An invitation had been received from Messrs. Lysaghts, Ltd., Orb Works, Newport, through the good offices of Mr. S. Whitmore, J.P.; and advantage was readily taken of this offer. Members assembled at the works, and proceeded to inspect the plant under the direction of Mr. Morgan, who conducted the party. Special interest was directed to the gas apparatus recently installed by the Newport Gas Company for heating up the rollers over the week-end; the idea being to heat the rollers to a certain temperature to allow immediate operations to be carried out upon the resumption of work on the Monday.

Later the members met at Fearis Café, Newport, where tea was provided by the Chairman and Directors of the Newport Gas Company.

Mr. J. RUST (Assistant Engineer and Manager of the Newport Gas Company) welcomed the members on behalf of his Chief, Mr. J. H. Canning, who was indisposed, and thus unable to attend.

Wishes for the speedy recovery of Mr. Canning to normal health again were expressed by the members.

Mr. T. NOALL (Cardiff) proposed a vote of thanks to Messrs. Lysaghts, Ltd., and to the Newport Gas Company, for the kind way in which they had been received that day. He was sure that what they had seen at Messrs. Lysaghts' works would prove of great value. Referring to the hospitality of the Newport Gas Company, Mr. Noall remarked that they were always assured of a welcome at Newport.

Mr. T. LANE (Cardiff) seconded the vote of thanks, which was carried unanimously.

COAL TAR.

By KELVIN JONES, of Newport.

[EXTRACT.]

THE HIRD TAR PLANT.

This consists of the following apparatus:

Three stills of cast iron, through which the tar is passed in series. Stills Nos. 1 and 2 each contain three 6-in. diameter boiler tubes. These tubes form the only medium by which the heat is transmitted to the tar, which is made to flow along the outside surface of the tubes by means of baffle plates. The tubes may be heated direct if a supply of coal gas or producer gas is available, or by a coke breeze furnace. Still No. 3 is heated by the hot gases from Nos. 1 and 2, which are passed through a flue beneath it, and thence to the chimney. A small quantity of steam is blown through the still by means of perforated pipes.

One pitch cooler of cast iron (the same size as the still), which also acts as a heat exchanger, fitted with tubes (similar to Nos. 1 and 2 stills) through which the crude tar is passed. The finished pitch overflows from the cooler without fumes, and is run direct to the pitch beds.

Three heaters. The products of distillation leaving the three stills are passed through cast-iron coils in the heaters, which consist of cast-iron casings through which the crude tar is passed in series before going to the pitch cooler. The heat from the vapours in the coils drives off the water and naphtha, which are collected from the tops of the heaters, pass through a separate coil, and are condensed.

The vapours from the stills are finally cooled and condensed in three condensers, from which the oil passes through sight overflow boxes to the receiving tanks.

It will be seen that the plant produces simultaneously four fractions of distillates, the character of which may be altered at will by varying the temperatures of the stills. Each still has its own heater, condenser, and sight overflow. Naphtha is produced from the heaters, light oil from No. 1 still, creosote oil from No. 2 still, and anthracene oil from No. 3 still. The temperature of each still is registered by an electrical pyrometer.

The substances obtained on the distillation of coal tar are divided up into classes depending upon the temperature at which they vaporize. They are:

Distillate.	Distilling Temp.	Constituents of Fraction.
Light oil or crude naphtha	to 170° C.	Benzene and homologues
Middle or carbolic oils .	to 230° C.	Carbolic acid and naphthalene
Heavy or creosote oil . .	to 270° C.	Constituents not usually separated
Anthracene oil	above 270° C.	Anthracene
Pitch	Residue in still	

TREATMENT OF THE PRODUCTS.

The light oil is usually redistilled, and the portion boiling between 80° and 150° C. is worked up for benzene and its homologues. It contains basic substances—namely aniline and pyridine—which are dissolved out by agitation with strong sulphuric acid. The acid is then withdrawn, and the oil treated with caustic soda solution, which removes any residual sulphuric acid, as well as carbolic acid. This is followed by agitation with water, after which the purified oil is fractionated. A special form of still is used which is heated by steam, and is furnished with a long fractionating column. The fraction first collected is known as 50 p.ct. benzene. The name signifies a mixture of benzene and its homologues toluene and xylene. In the case of 50 p.ct. benzene, 100 c.c. of the liquid yield on distillation 50 c.c. when the boiling-point reaches 100°. The higher boiling fractions are known as solvent naphtha (which is used for dissolving rubber in the preparation of waterproof fabrics) and burning naphtha (for illuminating purposes). The 50 p.ct. benzene by second distillation is separated into benzene, toluene, and xylene.

Many methods are used for separating the middle oils. The chief products obtained are:

Crystallized carbolic acid, cresols, heavy solvent naphtha, pyridine bases, and naphthalene.

Carbolic acid and cresols are used in the preparation of soaps and disinfectants, and widely in medical departments as antiseptics and deodorizers.

Naphthalene, one of the most abundant constituents of coal tar, is used in the industry of artificial colours; as a disinfectant, insect killer, and moth destroyer; in the dressing of wounds; and in many other ways it is called upon to play an important part in medicine and in the household. In industry

it is used for the tanning of skins, driving gas motors, and for the preparation of dynamite and other well-known explosives. It is also largely employed in the making of fire-lighters.

The creosote oils consist of a complex mixture of neutral and acid oils which are used extensively for the preservation of timber. In the ordinary way 1 c.ft. of timber requires on an average 1 gallon of creosote oil; and if you think of the millions of cubic feet of timber that have to be treated—such as telegraph poles, railway sleepers, and woodwork in dockyards, all over the world—you have a rough idea of the great world-need for creosote.

The anthracene oils contain a certain amount of carbolic acid, or phenol, and a considerable proportion of anthracene, which is one of the most important constituents of coal tar. It is a crystalline solid which, when pure, gives off a blue fluorescence. Anthracene separates out in the form of a greenish solid, which is filtered off, washed free from oil by the use of a little solvent naphtha, and finally pressed. Chemically pure, it is obtained by grinding up with caustic potash and lime, distilling, washing with solvents, and subliming. Up to the present, practically all the anthracene produced is used in the manufacture of colouring matters, though it has been employed in electrical insulators by fusing it with resin.

Coal tar pitch is applied to many industrial purposes, partly in the solid state, and sometimes dissolved in oils. The manufacture of patent fuel is the most natural outlet for the immense quantities of small coal obtained at the larger number of pits. It can be sold only at a low price, or sometimes not at all, and it is in this branch of industry that the principal employment of coal tar pitch is found. Very fine small coal is mixed, or "agglutinated," with soft pitch; the latter acting as a cement. The plastic mass is then placed in a briquette moulding machine; and under the influence of great pressure, the patent fuel briquettes are produced. The importance of this industry will be realized from the fact that the selling price of briquettes is usually the same as, and sometimes even higher than, that of lump coal.

Discussion.

Mr. C. B. FELTON (President) congratulated the author on his paper.

Mr. L. KLIEST (Cardiff) referred to the use of phenol for making horn-rimmed spectacles, &c. This was a new process.

Mr. NOALL, speaking of the gradual drop in the price of coal tar, remarked that it was up to the industry to obtain the best possible price for their product.

Mr. RUST said that years ago the gas industry had a tar monopoly; and in some parts of the country advantage was taken of the situation. No doubt they were suffering from the effects of that monopoly to-day. As a road product, coal tar was the best to use, for it gave a non-slip surface.

Others who took part in the discussion were Messrs. B. J. BELL, H. G. VICTORY, and A. H. DYER.

Mr. A. J. CRUISE (Cardiff) proposed a hearty vote of thanks to Mr. Jones, which was seconded by Mr. W. H. EVANS (Newport).

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Wages of Gasworkers at Port Talbot.

SIR,—I shall be glad if you will correct a statement which appeared in the "JOURNAL" for Jan. 16, p. 171, in which the name of the National Gas Council is quoted several times instead of the Federation of Gas Employers in connection with the representations which are being made by the Government Auditor to the Port Talbot Corporation with regard to the wages and conditions of the gasworkers.

The notice appearing in your paper gives the impression that the National Gas Council was the body which dealt with labour questions in 1921, whereas the truth of the matter is that the Federation of Gas Employers was formed in June, 1919, and has since that date been entirely responsible for all labour questions connected with the gas industry.

The National Gas Council takes no part whatever in questions affecting the rates of wages and conditions of gasworkers.

W. J. SMITH.

Federation of Gas Employers,
28, Grosvenor Gardens,
London, S.W. 1,
Jan. 21, 1929.

MISCELLANEOUS NEWS.

THE BLOOMSBURY EXPLOSION.

Resumed Inquiry.

The Inquiry into the Bloomsbury Explosion was resumed in the King's Bench, Court 2, at the Royal Courts of Justice on Monday, Jan. 21. Reports of the previous sittings appeared in the "JOURNAL" for Jan. 2, p. 50; Jan. 9, p. 105.

Monday, Jan. 21.

Mr. LIONEL WALFORD, Town Clerk, Holborn, said he had two witnesses who would speak regarding an escape of gas in this district four days before the explosion.

Mr. A. T. MILLER, K.C., said that the Gas Light and Coke Company had prepared a complete list of all openings and gas escapes in this area for two years prior to the explosion; and evidence would be given with regard to this.

The CHAIRMAN thereupon suggested that the evidence suggested by the Town Clerk of Holborn should be held back for the present, to avoid duplication.

Mr. MILLER suggested that, as there was a similar leakage taking place at one of the points of the 48-in. main in the area of the explosion to that which had been discovered at previous joints, the Gas Company should carry out a careful experiment to ascertain the precise amount of gas leaking per hour. What was intended was to cut and cap the particular section of the main near the Princes Theatre, and maintain the pressure in it, in order to measure the leakage through the joint. It was also desired to examine the nature of the clay round the joint, to see whether it was the natural clay of the district, or whether it was imported clay. The case for the Gas Company, which would be developed later, would be that, even without the clay joint, the amount of gas leaking was infinitesimal, and that with the clay joint none could percolate into the surrounding soil.

The ATTORNEY-GENERAL said he had no objection to this being done, provided there were present representatives of the parties concerned.

Mr. MILLER replied that the Gas Company would be pleased to have the assistance and co-operation of anybody in carrying out the test.

The ATTORNEY-GENERAL said he would also desire information as to the extent of the leakage at the other joints, as he understood that every joint which had been opened on the high-pressure main had been found leaking.

The Metropolitan Water Board's evidence was then taken.

Mr. *R. E. Morris* (Divisional Engineer, Northern Section, Metropolitan Water Board) gave details of the water supply in the area of the explosion. He suggested that, to avoid interference with underground mains from vibration due to traffic, there should be a distance of 3 ft. between the top of the mains and the bottom of the concrete foundation of the road. With a good road surface there was not the same risk of damage as when the road surface was a bad one. In the case of water mains, there was "drawing" of the joints in consequence of the vibration from above.

The CHAIRMAN raised the question of the risk to mains of any sort when they had to twist and deviate, in order to avoid other mains.

Witness agreed that the straighter a main could be laid, the better for its life and operation. Every bend or twist increased risk to the pipe. He added that he much preferred to lay trunk water mains in a subway.

Mr. *F. Elstob* (Mains Superintendent of the London Hydraulic Power Company) gave details of the mains of his Company in the explosion area.

Asked by the Chairman for his experience of the effect of modern conditions of traffic upon underground mains, witness said most trouble was caused by the continual openings of the surfaces alongside existing mains, and the after-effect of the shaking-down of the made-up ground in filling-in these excavations. Gradually, as a consequence, his Company were replacing all their cast-iron mains by toggle-jointed steel mains. He also preferred to lay mains in subways.

Major *H. Richardson* (Managing Director of the Metropolitan Electric Supply Company) produced a plan of his Company's mains in the area. He said that the Company's street boxes carrying low-tension cables were of the usual type, approximately 2 ft. by 2 ft. by 2 ft. deep, built of brick and fitted with iron covers. They were all on low-tension cables; and he regarded the covers as air-tight. They were periodically examined on a definite system, according to the Company's own regulations. The Company ventilated all chambers, such as transformer chambers, for its own purposes, to keep them clean and sweet for the men to work in; but he admitted that it was practically impossible thoroughly to ventilate small street boxes. There were some engineers who thought that the partial ventilation of such boxes added to the danger of explosion rather than minimized it.

Witness said that the primary object of inspecting street boxes and other chambers was to see that the apparatus was in first-class order, and not for ventilation; although incidentally the boxes were ventilated. He had heard rumours of gas accumulating in these boxes, but that had not been his general experience.

The ATTORNEY-GENERAL: Have you in mind an accumulation of coal gas?

Witness said he had been careful not to mention any particular kind of gas. Pressed on the matter, he agreed it was possible for a mixture of coal gas and air to accumulate in one of these street boxes.

Mr. A. T. MILLER put it to witness that all the 28 boxes which the Metropolitan Electric Supply Company had in this area would have been opened within a week of the explosion.

Witness agreed, and added that, if his men had detected gas in any of the boxes, they would have notified the Gas Company.

Mr. MILLER referred to a regulation of the Electricity Commissioners which provided for the ventilation of any street box of a capacity of more than 1 cubic yard.

Witness said that none of his street boxes in the neighbourhood of the explosion was as large as that.

Mr. MILLER mentioned that the Westminster Electric Supply Corporation ventilated all their street boxes.

Witness expressed doubt as to the possibility of doing this effectively.

In answer to the CHAIRMAN,

Witness said that, though he had had no trouble with his mains in subways, he had mixed feelings on the matter. There was an almost inevitable interference of one authority with the mains of another; but perhaps worse than this was the danger. If a gas main was fractured, and an electric main developed a fault at the same time—perhaps both due to outside causes, such as a bad subsidence—a fire would be started in the subway. Speaking generally, he would prefer not to lay high-tension mains in subways. They would be much safer underground, without any space around them.

Mr. MILLER recalled that at the Embankment subway last year a fire on an electric main occurred in close proximity to a gas main, and caused the Gas Company great anxiety.

It was here indicated that no complaints had been made of gas in the Metropolitan Supply Company's street boxes for some months before the explosion.

Dr. *S. L. Pearce* (Chief Engineer to the London Electric Power Company) expressed the view that high-tension mains should be laid direct in the ground, and as deep as practically possible. He certainly did not recommend laying such cables in subways.

Answering the CHAIRMAN,

Witness said that a depth of 6 ft. to 8 ft. would be necessary for high-tension mains in future.

Mr. *W. B. Thorpe* (Chief Engineer to the Charing Cross Electricity Supply Company) produced a plan of the area, showing his Company's mains, which are low-tension. The Company, he said, still had some bitumen cables in the roads, but they had been abandoned, and were not used.

Asked for his opinion as to subways, witness said that, where they were laid on either side of the road, they were a great advantage from the point of view of running-in services.

Witness told the Chairman that there had been a few explosions in his Company's street boxes. One case was that of a man working in a street box with a blow lamp which ignited coal gas; the explosion blowing up the cover of another box 100 yards away. This happened last summer; and the Gas Company found a broken main. Doing away with the old bitumen mains had prevented the explosions that occurred years ago due to hydrocarbon gas from the distillation of the bitumen.

Replying to the ATTORNEY-GENERAL,

Witness said he did not think open grating covers to electrical street boxes would be possible; and he had deliberately adopted the non-ventilated type. There was no practical system of adequate ventilation of street boxes other than large transformer chambers, except by opening up.

During a general discussion as to future procedure, reference was made to a leakage of gas at 216, Shaftesbury Avenue, four days before the explosion on Dec. 20; and the question of hearing evidence regarding it was mentioned.

Mr. MILLER said he had witnesses to speak on this, though it was outside the particular area of the explosion.

The CHAIRMAN said that the Commissioners were aware of this occurrence through the usual police reports, and he had intended to mention it during the inquiry.

DIARIES, CALENDARS, &c.

From the following firms further gifts in the form of calendars and blotters are acknowledged:

Gas Light and Coke Company.
Mobberley & Perry, Ltd., Stourbridge.
Whitehaven Colliery Company, Ltd., 51, Duke Street, Whitehaven.

GAS REGULATION ACT APPLICATIONS.

SPECIAL ORDERS.

Horsham Gas Company, Ltd.

To extend the limits of supply, to authorize the raising of additional capital, &c.

Watford Gas and Coke Company.

To provide for the transfer to the Company of the undertaking of the St. Albans Gas Company, &c.

STOCKPORT GAS TRAGEDY.

Inquest Concluded.

Mr. R. STUART RODGER, the Lancashire County Coroner, on Jan. 16 concluded his inquiry into the cause of the deaths of Arthur Horace Baker, aged 35, his wife, and their four children, who lived at 71, Sheffield Street, Heaton Norris, and, in the early morning of Nov. 30, were found dead in the house (see "JOURNAL" for Dec. 5, p. 683). There was a fracture of the gas main in the street in front of the house, which was full of gas. Neighbours living on either side were found to be suffering from gas poisoning.

A verdict of "Death from misadventure" was returned.

The Coroner opened the inquest on Dec. 1 for identification, and adjourned it until Dec. 11, when he took evidence. He adjourned the inquiry again in order that experiments could be made as to pressure, strains, and stresses on the gas pipes (see "JOURNAL" for Dec. 19, p. 804).

When the inquiry was resumed on Jan. 16, Mr. Newbigging, Civil Engineer, gave the results of practical tests which he had made of breaking a 2-in. cast-iron main, and his calculations of the theoretical breaking load were as follow:

A 2-in. cast-iron main, 6 ft. long, was loaded at a point 2 ft. from the socket (representing the position of the service pipe) until it fractured. The breaking weight was 2275 lbs. A second test, made under exactly similar conditions, fractured the main at 2359 lbs. A third test was made by dropping a load through a distance of three inches (the depth of the subsidence of the wall footings), the loads being released by means of a snatch block. In this test the pipe was fractured under a load of 427 lbs. A fourth test, made under exactly similar conditions, fractured the main at 511 lbs.

He did not think that the earth pressure at the back of the brickwork was due to the same cause as that of the subsidence of the brickwork; nor did he think that the traffic vibration had anything to do with the fracture. He gave his calculation of the stress due to the falling brickwork, saying that the resultant force of brickwork and earth pressure was 400 lbs. He was of opinion that temperature might have had a contributing effect.

Mr. *H. Hamer*, the Borough Surveyor, said that he considered the subsidence of the house footings, together with the earth, caused a strain to be put on the service pipe, which was transmitted to the main, thus causing the fracture. There was no indication outside that there was any subsidence. The effect of traffic vibration was problematical. The property was well looked after, and the necessary repairs had been carried out.

CORONER'S FINDINGS.

The CORONER, returning his verdict, said that the following were his findings:

The cause of death was poisoning by coal gas escaping from a fractured main, and finding its way through dropped footings into the dwelling-house.

1.—I find all the gas distributing material was sound.

2.—I find the main and service pipes were well and truly laid.

3.—The fracture of the main was of quite recent origin.

4.—There is evidence of percolation of surface water flowing in the direction of the river, and this produced a local subsidence of three courses of bricks in the foundations of the house front, caused them to press the service pipe, and this pressure was gradually reinforced by a large amount of solid earth gradually moving by reason of this flow of water some feet below the rock surface.

5.—The main being subjected to this inordinate pressure, the actual fracture may possibly have occurred during some heavy traffic vibration, or the courses of bricks being loosened may have suddenly dropped and produced a shock effect on the main, this shock being transmitted through the service pipe and cement trough.

6.—No external defect was apparent near the main, service, or house pipes. There was neither recent cracking of the walls nor any subsidence of house floor or pavement. Therefore the cause or causes of this fracture could not be foreseen and provided against, and I find no evidence of personal negligence. As the cause of the fracture is inherently peculiar, and dependent on extraordinary circumstances, I fail to see that any instructions could be given to the gas distribution department which would obviate a similar fracture, the chances of a similar circumstance re-occurring being, perhaps, one in a million.

BURY ST. EDMUND'S GAS COMPANY.

Application for a Special Order.

The Bury St. Edmund's Gas Company held an extraordinary meeting on Friday, Jan. 18, when an application to the Board of Trade for a Special Order conferring further powers on the Company was approved.

The CHAIRMAN (Mr. J. Ridley Hooper) said that, with the exception of the Order made in 1921, declaring the calorific value of the gas supplied by the Company, and varying the standard price, it was fifty years since any amendment had been made in the constitution and powers of the Company. The present action had been under consideration for some time. During the last fifty years great changes in industry had come about. The advent of electricity in Bury St. Edmund's, and the extraordinary development of gas for heating and cooking purposes, had made it imperative to bring the works up to date. The sale of gas in Bury St. Edmund's in 1878 was 31 million c.ft., in 1888 37½ million c.ft., and in 1898 45 million c.ft. Shortly after then the Town Council inaugurated their electricity undertaking, and the public lighting of the Borough passed from the Gas Company to the Corporation. Thus in 1908 the output of the Company was only 44 million c.ft. In 1918 it had risen to 57 millions, and in 1928 to 83 millions; the rate of progress during the past ten

years being nearly 50 p.ct. As a consequence, large sums of money had been spent since the war in maintenance, renewals, and improvements, and in the extension of mains and services.

With regard to the present proposals of the Company, and dealing first with those relating to finance, the Chairman said that the scheme should prove of advantage to the shareholders. In 1921, the Company raised £9000 by the issue of bonds of £50 each, carrying interest at 5 p.ct. They had also unissued capital of £19,000; but the Directors felt that to raise further share capital in this form would not be economical.

There were three classes of shares in the Company—1200 £10 shares issued in 1849, which had received a dividend of 10 p.ct.; 1800 shares issued in 1859, which had received a dividend of 7½ p.ct.; and 100 shares issued in 1879, which had received a dividend of 7 p.ct. Every holder of consolidated stock would be entitled to one vote for every £10 of such stock.

It would be to the advantage of the Company and its shareholders to convert these shares into stock, and make them all of uniform value, without at the same time giving any advantage to the holders of the 1849 capital which would not be fully shared by the holders of the 1859 and 1879 capital. It was therefore proposed to give to the holders of the 1849 capital £20 of 5 p.ct. consolidated stock for every £10 share; to the holders of the 1859 capital £15 of consolidated stock for every £10 share; and to the holders of the 1879 capital £14 of 5 p.ct. consolidated stock for every £10 share. This would increase the nominal capital of the Company to £52,400; but the dividend on this amount at 5 p.ct. would be exactly the same as paid for a number of years past. The stock would be transferable in any sum; and they were of opinion that a freer market for purchase and sale would be established. At the same time it was proposed to increase the borrowing powers of the Company from £9000 to £15,822, which was half the amount of the present capital inclusive of premiums. This would place the Company in the position of being able to borrow on the most favourable and economical terms, and was necessary, bearing in mind the consistent progress which the Company had made since the war.

They had a reserve fund, which could only be applied to the payment of dividend in any year in which the clear profits would be insufficient to enable the Company to pay the standard rate of dividend on the share capital. It was now proposed to create a special purposes fund to provide for expense incurred by reason of accidents, strikes, or circumstances which due care and management could not have prevented, and expenses incurred in the replacement or removal of plant which came outside the actual maintenance and renewal of plant. It was also proposed to create a fund for the purpose of meeting expenses necessary for the maintenance and renewal of plant and works, which would take the place of the ordinary depreciation allowances for plant and machinery which were usual in the case of any concern. These reserve funds would each be limited in amount to one-tenth part of the paid-up capital of the Company.

As to the other proposals of the Draft Order, the Chairman said they also felt that, as building development was taking place in several directions on the outskirts of the town, it was desirable to apply for an extension of the limits of the present supply, which was confined to the borough only; and they were applying for power to embrace all the neighbouring parishes.

COAL TRADE REPORTS.

From Our Own Correspondents.

NORTH-EAST COAST.

There has again been great activity throughout the week, and all available supplies of coal have been readily taken. Northumberland, which has now been busy for some time, continues to do good trade, while an all-round improvement in the Durham market has been gaining strength in the past two or three weeks. There is at present a really good demand for all early positions, and prices are hardening for prompt shipments. Those who had not bought to cover their commitments were finding great difficulty last week in getting their cargoes stemmed, such was the pressure for coal.

Like many movements in the coal trade, this one has come suddenly and unexpectedly; and it is difficult to give any particular reason to account for it. At present, buying is confined chiefly to early dates. If, however, the present strength continues, it is to be expected that the forward position will harden also.

The best indication of the improvement which has taken place is the better position of all second-class coals, which are usually the last to benefit. For instance, secondary gas coals are now well stemmed all round, and are quoting 13s. 9d. to 14s. f.o.b., which is an advance of at least 6d. Wear Specials ask 15s. 3d. to 15s. 6d., and best qualities 14s. 9d.

After a long period of idleness, coking coals have been one of the chief features, and exporters have been unable to satisfy their requirements for ready boats, so great is the demand. Normal quotations are now 13s. 9d. to 14s., but even more is said to have been paid for spot lots. Durham unscreened bunker sorts are active. Best makes are scarce, and quote firmly 14s. 3d. to 14s. 6d. Seconds are in improved demand, and ask 13s. 6d. to 14s.

There is rather more activity in gas coke, but stocks are still ample. For shipment, 18s. 9d. f.o.b. is asked.

YORKSHIRE AND LANCASHIRE.

Gas coals are inclined to appreciate on account of consumers purchasing ahead before the ordinary time of buying. Contracts have already been made for deliveries over twelve months commencing next January (1930) at figures a little above present prices.

Industrial coal, especially washed fuel, is inclined to be firm, with forward prices slightly advanced.

The export section report insufficient supplies for all requirements; collieries being sold well ahead both for this month and for February. Business on that account is extremely difficult, while the bunkering trade is also very spasmodic.

MIDLANDS.

There is more movement in the market not only so far as domestic fuelling is concerned, but in the industrial and gas coal sections. Deliveries of gas coal have got behind owing to the dislocations of the Christmas season, and, with consumption at the maximum, engineers have been eating into reserves. Hence they are pressing for the speeding up of deliveries.

Signs of market stringency are apparent in one or two directions only. The increased demand for slacks and smalls for electricity undertakings and central heating has caused prices to stiffen. Quotations generally move from 7s. upwards for good nutty slacks. Supplies are still obtainable at less than the figure named; but spot lots are no longer being offered, equilibrium having been re-established between supply and demand.

Best grades of household coals are still in strong request. At Cannock Chase and some other collieries lists have been revised upwards; the advance amounting to an average of about a shilling. Transport has not been seriously interrupted, except in some areas where snow has impeded distribution by road. Many of the collieries in the Five-Counties Scheme produced considerably more than their quota of 62½ p.ct. during the first three weeks of January, notwithstanding irregularities at the turn of the year. Outside pits have been working at full pressure latterly.

Coke suppliers have put up their price for blast-furnace coke to 14s. 6d. at ovens. The advance is being resisted by smelters.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Jan.* 21.

Tar products generally continue quiet; current values being as follows:

Pitch, about 37s. 6d. per ton.

Creosote, about 7d. per gallon.

Pure benzole, about 1s. 9d. to 1s. 10d. per gallon; pure toluole, about 2s. 1d. per gallon; and 95/160 solvent naphtha, 1s. 5d. to 1s. 6d. per gallon.

Pyridine, about 4s. 3d. per gallon.

Tar Products in the Provinces.

Jan. 21.

There is practically no variation in the markets for tar products.

Pitch is still very quiet, and business has again been done at 35s. f.o.b.

Creosote is unaltered, and orders for home consumption are very difficult to obtain.

Other products are unchanged.

The average prices of gas-works products during the week were: Gas-works tar, 23s. to 28s. Pitch—East Coast, 35s. to 36s. f.o.b. West Coast—Manchester, 30s. to 30s. 6d.; Liverpool, 32s. to 33s.; Clyde, 32s. to 33s. Toluole, naked North, 1s. 5d. to 1s. 6d. nominal. Coal-tar crude naphtha, in bulk, North, 9d. to 10d. Solvent naphtha, naked, North, 1s. 1½d. to 1s. 2d. Heavy naphtha, North, 1s. to 1s. 0½d. Creosote, in bulk, North, liquid, 4⅝d. to 4⅞d.; salty, 4½d. to 4¾d.; Scotland, 4½d. to 4¾d. Heavy oils, in bulk, North, 8¼d. to 8½d. Carbolic acid, 60 p.ct., 1s. 10d. to 1s. 11d. prompt. Naphthalene, £13 to £15; salts, £5 to £5 10s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

Benzole Prices.

The following are considered to be the market prices to-day:

	s. d.		s. d.	
Crude benzole . . .	0 10	to	0 10½	per gallon at works
Motor ,, . . .	1 4	,,	1 4½	,, ,, ,,
90 p.ct. ,, . . .	1 7	,,	1 8	,, ,, ,,
Pure ,, . . .	1 10	,,	1 11	,, ,, ,,

CONTRACTS OPEN.

Gasholder.

The Urban District Council of Filey invite tenders for a two-lift spiral holder. [See advert. on p. 238.]

Retorts.

The Loughborough Corporation Gas Department invite tenders for the renewal of retort beds. [See advert. on p. 238.]

Stores, Tools, &c.

The Corporation of Ossett invite tenders for the supply of materials, stores, tools, &c., for various departments. [See advert. on p. 238.]

TRADE NOTES.

New Plant at Hunstanton.

The Hunstanton Urban District Council have placed an order for a retort bench, two purifiers 15 ft. square by 5 ft. deep, and Livesey washer, with Messrs. Robert Dempster & Sons, Ltd., of Elland.

Lighting Trades Staff Dinner.

The Annual Staff Dinner and Dance of Lighting Trades, Ltd., of Oriel House, Farringdon Street, E.C. 4, was held at the Piccadilly Hotel on Friday last. The gathering numbered 160, and was presided over by Mr. H. J. Mitchell, the Chairman of the Company, supported by other members of the Board. After the Loyal Toast, Mr. Mitchell, in proposing "The Staff of Lighting Trades, Ltd.," expressed his pleasure in again presiding at their annual festive gathering, and in welcoming on this occasion the Chairman (Mr. J. R. Yates) and several members of the Welsbach Light Company, which was recently acquired by Imperial Chemical Industries, Ltd. Not the least interesting feature of the evening was the presentation to four members of the staff who had completed 25 years' service. The presentation took the form of a silver medal and a silver watch. In congratulating the recipients (Messrs. W. G. Mason, C. B. Clarkson, A. C. Spearing, and J. Warburton), Mr. Mitchell expressed the hope that all present would in due course qualify for these tokens. Mr. Albert T. Metcalfe, the General Manager, in responding to the toast, thanked the Directors on behalf of the staff, for the enjoyable evening they had provided.

Additions to Bolton Showrooms.—The Bolton Gas Department have completed alterations to their showrooms in Hotel Street, having converted the entrance yard into a demonstration room where cookery lectures are to be given.

Bloomsbury Gas Explosion.—At a meeting of the Committee of Management of the Royal Westminster Ophthalmic Hospital, Holborn, at which Lord Arran, the Chairman, presided, a vote of thanks was passed unanimously for "the very valuable services rendered by the Metropolitan Water Board, the Gas Light and Coke Company, and the Charing Cross Electricity Supply Company, Ltd., during and after the gas explosion in December last." The Committee also recorded their deep appreciation of "the strenuous efforts of the men employed, and the admirable courage displayed by them in returning to their arduous and dangerous task after being gassed."

Gas Explosion at Lee Green.—About 10.15 on Friday night, Jan. 18, a gas explosion occurred in High Road, Lee Green, wrecking the fronts of two shops. The premises were severely damaged, the stocks being blown into the roadway, and a large amount of glass smashed. Nobody was injured. Mr. E. B. Dodd, son of the proprietor of one of the damaged shops, stated on Saturday that Mr. Dodd was about to leave the shop, and was approaching the front door, when he saw blue flames creeping across the ceiling near the window. Then the explosion occurred. There was a blaze about 2 ft. high of gas in the basement, which was put out with an extinguisher. The cause of the explosion is believed to be a fault in a 6-in. main.

Hemel Hempsted New Stock Issue.—The tenders for the new capital which was offered by Messrs. A. & W. Richards, of 37, Walbrook, E.C. 4, on behalf of the Directors of the Hemel Hempsted and District Gas Company, were opened on Jan. 16. (See "JOURNAL" for Jan. 9, p. 112.) For the £6000 ordinary stock, tenders were sent in for £24,450 at prices ranging from £107 down to the minimum of par, the lowest price to secure allotment being £101 16s. p.ct. The average price obtained was £102 11s. 11d. p.ct. For the £6000 6 p.ct. redeemable debenture stock, tenders were sent in for £28,900, ranging from £103 down to the minimum of par. The lowest successful tender was at £101 p.ct., and the average price obtained was £101 8s. 5d. p.ct.

The East Surrey Gas Company.—The amalgamation of the Dorking Gas Company with that of the Redhill Gas Company under the title of the East Surrey Gas Company has now received the approval of Parliament. The combined undertaking—responsible for the supply of gas over an area of approximately 120 square miles, and serving nearly 14,000 consumers through 190 miles of mains—announces the following reductions in the price of gas in the Dorking district: For ordinary meter supplies consumers will benefit by a reduction from 15d. per therm to 13·2d. per therm, and this will apply to all gas consumed after Oct. 1 last. For gas engine supply—by special meter—when the consumption exceeds 250 therms per annum, the following discounts will be allowed off the ordinary charge. During the year ended Dec. 31—off the first 500 therms, 7½ p.ct.; off the following 1000 therms, 10 p.ct.; off the following 2000 therms, 15 p.ct.; and all consumptions over 3500 therms, 20 p.ct. These terms will apply as from Oct. 1 last, and, in addition, the whole of the gas consumed for power purposes during the year 1928 will be taken into account when calculating the discount. The charges for meter hire have also been reduced.

Lecture on Gas Ovens at Sutton.—The staff and fitters of the Sutton Gas Company spent an instructive afternoon listening to a lecture given in the Social Room at the works on Jan. 9, by Mr. Arthur Forshaw, Chief Chemist to Messrs. R. & A. Main, Ltd., on the "Construction of Gas Ovens, and the Comparison of the Performance of Various Types." The chair was occupied by Mr. Henry Gage, the Engineer and Manager, who was supported by the Distribution Superintendent, Mr. J. Davis. The lecturer, with the aid of drawings, lantern slides, and cookers, described the construction of various types of cooker now in every-day use. He emphasized the features of each, and the advantages of particular designs for special purposes. He also described in detail the working of the "Mainstat" in conjunction with the oven, and pointed out the economy effected by the use of this appliance. He also demonstrated how an even cooking temperature throughout the oven could be maintained by the products of combustion leaving at the base instead of the top of the oven. The address lasted about two-and-a-half hours, after which various points were raised by the staff, and a good discussion followed. A hearty vote of thanks was accorded to Mr. Forshaw on the proposition of Mr. J. Davis.

A Leeds Gas Exhibit.—The Leeds Corporation Gas Department have a striking stand, showing labour-saving gas appliances for domestic uses, and various forms of artistic lighting, at a Building Trades Exhibition, promoted by the "Yorkshire Post," at the Fenton Street Drill Hall, Leeds, from Jan. 16 to 26. Special emphasis is laid on the effective manner in which gas undertakings co-operate with architects and builders in providing for the comfort of the home, coupled with artistry and the elimination of smoke. The stand has a useful feature in the display of an obsolete gas fire in close proximity to the latest type of silent fire with the new "Thermo-XX Beam" radiants. Cookers, water heaters, and smokeless solid fuel (gas ignited) fires form an exhibit which produces a convincing argument for the greater use of gas.

Sir John Cass Technical Institute.—The Governors of this Institute are extending their existing courses in Fuel Technology by an advanced and post-graduate course on "Coal Carbonization." The inaugural lecture will be delivered by Dr. F. S. Sinnatt, M.B.E., D.Sc., F.I.C., of the Fuel Research Board, on Jan. 28, at 7 p.m. In the Department of Organic and Applied Chemistry there will be a course of twelve lectures on "Coal Carbonization" by Mr. H. D. Greenwood, M.Sc., A.I.C. This course is of an advanced nature designed to meet the requirements of those interested in fuel technology, with special reference to gas manufacture and the production of coke and smokeless fuel. The lectures will be held at 7 p.m. on Monday evenings, commencing Feb. 4. Seven lectures will be delivered before Easter and five lectures after Easter. The fee for the course is 15s.

Advantages of Refracting Glass in Lamps.—Mr. Robert Watson, Borough Gas Engineer and General Manager at Doncaster, with the approval of the Gas Committee of the Corporation, has been experimenting on a number of lamps in Thorne Road and Dockin Hill Road, with the use of refracting glass instead of ordinary glass. Mr. Watson points out that ordinary glass directs many of the light rays from the burner upwards, creating waste. Refracting glass directs most of the rays to the centre of the roadway between the gas standards, resulting in very appreciable lighting improvement. Though the glass is rather more costly, the maintenance costs in regard to burners and mantles are unaffected, and the Gas Committee regards the little extra cost as amply justified by the improved street lighting. The Watch Committee have been asked for their approval for the general equipment of the town's lighting with refracting glass.

Further Leakages in the Rhineland.—A third serious leakage in a long-distance main of the Ruhr Gas A.G. at Duisberg is reported. Only one of the mains of the Company has been completed, and it is in this line that the three leakages have occurred—all at Duisberg. (See "JOURNAL" for Jan. 9, p. 112.) This last leakage occurred in an open space, and no loss of life ensued. In all three cases the leakages have been due to fractures of the welded joints. A new section of pipeline has just been completed, and it is understood that it will be put to the most severe tests before being passed for use. A Committee of experts are considering what steps can be taken to avoid any further leakages; and one proposal is that at each pipe junction a free shaft ending in a small grating shall be constructed. The pipelines are laid in sections of 16 yards, so that joints will be so numerous as to make the adoption of this plan somewhat expensive.

Cookery Demonstrations at Brighton.—On Jan. 15 the winter session of free lectures and demonstrations in gas cookery, arranged by the Brighton and Hove General Gas Company, commenced in their well-appointed cookery room in Church Street, Brighton. Under the direction of the lady demonstrator, Mrs. E. Iredale, and her two assistants, Miss D. N. Tayler and Miss E. J. Gott, the autumn session was remarkably successful, and the large attendance at the recommencement of the series had been anticipated. Demonstrating with both large and small types of cooker, Mrs. Iredale and her assistants give practical and useful lessons in the perfect preparation of gas-cooked food. The lecture-demonstrations will be continued three times weekly: Tuesday and Thursday afternoons at 3 o'clock, and Wednesday evenings at 7 o'clock. In addition, Mrs. Iredale and her assistants are in attendance daily from 2.30 p.m. to 4.30 p.m., to give users of the Company's cookers the benefit of their expert knowledge.

Low-Temperature Carbonization Address.—Lieutenant-Colonel W. A. Bristow, M.I.E.E., in a paper read at a meeting in Glasgow of the Institution of Engineers and Shipbuilders in Scotland—Mr. R. T. Moore, B.Sc., the President, in the Chair—dealt with low-temperature carbonization of coal. Having described the different processes and plant, and explained their respective advantages, Colonel Bristow said the production of smokeless fuel by the low-temperature carbonization of coal had been developed to a very high state of efficiency, and so far as this aspect was concerned the process could be said to be on a commercial and profitable basis. There was an enormous demand for the fuel, and already a number of new works were in course of construction or had been definitely contracted for. The application of low-temperature carbonization to other purposes was not, however, in anything like such a highly developed state; but it was probable that the prospects in these other fields might be materially improved by the work that was now being done in connection with the conversion of low-temperature coal oil into petrol. The issues at stake were vital, the national importance of both the necessity for smokeless fuels and the oil situation could hardly be overestimated, and he saw no reason why low-temperature carbonization should not become one of the greatest and most successful of British industries.

The death occurred on Jan. 5, in the Dundee Royal Infirmary, of David Stott (52), as a result of injuries sustained at the Corporation Gas-Works. Stott and another employee were ascending in an elevator when it collapsed and fell a distance of nearly 20 ft.

STOCK AND SHARE LIST.

[For Stock Market Report, see earlier pages.]

Issue. £	Share.	When ex-Dividend.	Dividends, Prev. Hf. Yr. % p.a	Dividends, Last Hf. Yr. % p.a.	NAME.	Quotations. Jan. 18.	Rise or Fall on Week.	Transactions Lowest and Highest Prices.
171,978	Stk.	Aug. 30	5	5	Aldershot 5 p.c. max. C.	72—77	..	..
412,992	,,	,,	4	4	Do. 4 p.c. Pref.	69—72	..	..
1,551,868	,,	Sept. 27	7	7½	Alliance & Dublin Ord.	98—101	..	99½—100½
874,000	,,	Jan. 10	4	4	Do. 4 p.c. Deb.	68—66*	..	..
522,654	,,	Aug. 30	7	7	Barnet Ord. 7 p.c.	114—117	..	..
300,000	1	Oct. 11	1/7½	1/4½	Bombay, Ltd.	20/—22/-	..	22/-
170,000	10	Aug. 30	8½	8½	Bournemouth 5 p.c.	12½—13½	..	13
600,050	10	,,	7	7	Do. B 7 p.c.	12½—13	..	12⅞—13
375,000	10	,,	6	6	Do. Pref. 6 p.c.	11—11½	..	11⅞—11⅞
50,000	Stk.	Jan. 10	3	3	Do. 3 p.c. Deb.	55—58*	..	..
162,025	,,	,,	4	4	Do. 4 p.c. Deb.	74—77*	..	..
257,900	,,	Aug. 30	7½	7½	Brighton & Hove 6 p.c. Con.	116—118	..	..
341,880	,,	,,	6½	6½	Do. 6 p.c. Con.	101—104	..	103½—103½
1,287,500	,,	July 26	5	5	Bristol 5 p.c. max.	93½—94½a	+½	..
855,000	,,	Sept. 27	7	8	British Ord.	116—118	..	117—117½
100,000	,,	Dec. 20	7	7	Do. 7 p.c. Pref.	115—120	..	..
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb.	73—76	..	76
200,000	,,	,,	5	5	Do. 5 p.c. Red. Deb.	93—96	..	..
100,000	10	Dec. 6	8	6	Cape Town, Ltd.	8—9	+½	8⅝—9
100,000	10	Oct. 25	4½	4½	Do. 4½ p.c. Pref.	6¾—7½	..	..
150,000	Stk.	Dec. 20	4½	4½	Do. 4½ p.c. Deb.	71—76	..	..
496,860	,,	July 26	6	6	Cardiff Con. Ord.	97—100	..	..
287,860	,,	Jan. 10	7½	7½	Do. 7½ p.c. Red. Deb.	98—101*	..	..
157,150	,,	Aug. 16	6½	5	Chester 5 p.c. Ord.	89—94b	..	..
79,185	1	Oct. 11	1/-	1/-	Colombo Ltd. Ord.	36½—38/	..	..
24,495	1	,,	1/4½	1/4½	Do. 7 p.c. Pref.	21-/—23/-	..	..
375,402	1	Oct. 11	1/9½	1/9½	Colonial Gas Assn. Ld. Ord	24/—26/-	..	..
187,848	1	,,	1/7½	1/7½	Do. 5 p.c. Pref.	21/—23/-	..	..
2,073,280	Stk.	July 26	7	5	Commercial Ord.	98—101	..	99¾—100¾
475,000	,,	Dec. 20	3	3	Do 3 p.c. Deb.	56—59*	..	58½
800,000	,,	Sept. 27	11	11	Continental Union, Ltd.	127—133	+7½	119½—133
200,000	,,	,,	7	7	Do. 7 p.c. Pref.	123—128	+5	125
787,560	,,	Aug. 16	7	7	Croydon sliding scale	110—113	..	112—113
403,100	,,	,,	5	5	Do. max. div.	84—87	..	86—87
492,270	,,	Aug. 16	10	7	Derby Con.	115—120e	..	..
55,000	,,	Dec. 20	4	4	Do. Deb.	70—72e	..	..
309,000	,,	Aug. 30	5	5	East Hull Ord. 5 p.c.	75—78	..	..
1,002,180	10	Sept. 13	†6	†4	European, Ltd.	11—12	..	11½—11⅝
18,708,480	Stk	July 26	5/11¼	5½	Gas Light & Coke 4 p.c. Ord.	19/—19/6f	+-/9	18 7½—19/4½
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	64—66	..	64½—65½
4,157,020	,,	,,	4	4	Do. 4 p.c. Con. Pref.	79—82	+1	79½—80½
5,603,620	,,	Dec. 20	3	3	Do. 3 p.c. Con. Deb.	59—61	..	60—61
181,315	,,	,,	6	6	Do. 6 p.c. Br'tf'd Rd. Db.	102—105	..	..
1,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb.	98—101	+½	100—101
42,000	,,	—	7½	7½	Do. 7½ p.c. Ilford Deb.	..	..	..
89,500	,,	Aug. 30	6½	7	Hastings & St L. 5 p.c. Conv	95—100	..	..
268,740	,,	,,	5½	5½	Do. 5½ p.c. Conv.	75—80	..	..
70,000	10	Oct. 11	†10	†10	Hongkong & China, Ltd.	13—14	..	..
173,200	Stk.	Aug. 30	5	5½	Hornsey Con. 3½ p.c.	88—91	..	90
1,976,000	,,	Nov. 8	10	10	Imperial Continental Gas.	270—290	+30	245—285
228,180	,,	Aug. 16	8½	8½	Do. 3½ p.c. Red. Deb.	67—69	..	..
285,242	,,	Aug. 16	7	7½	Lea Bridge 6 p.c. Ord.	116—121	..	..
2,145,907	,,	Aug. 16	5½	5½	Liverpool 5 p.c. Ord.	90½—91b	..	..
600,000	,,	Sept 27	7	7	Do. 7 p.c. Red. Pref.	101—103b	+½	..
165,736	,,	Aug. 16	8	9	Maidstone 5 p.c. Cap.	124—129	..	..
63,480	,,	Dec. 20	3	3	Do. 3 p.c. Deb.	54—57	..	..
75,000	5	Dec. 6	†8	†8	Malta & Mediterranean	5½—6	..	..
392,000	—	—	—	—	Metrop't'n (of Melbourne) 5½ p.c. Red. Deb.	99—101	..	101½—101½
641,920	Stk	Nov. 22	†7	†5	Montevideo, Ltd.	97—100	+2½	96½—97
2,061,315	,,	Aug. 16	5	5	Newcastle & Gateshead Con.	17/3—17/9d/	..	..
360,929	,,	,,	4	4	Do. 4 p.c. Pref.	73½—74½d	..	..
691,705	,,	Dec. 20	8½	8½	Do. 8½ p.c. Deb.	68—69d	..	..
181,780	,,	Aug. 30	6/18/0	7/1/0	North Middlesex 6 p.c. Con.	102—107	..	..
400,000	,,	Nov. 22	7	9	Oriental, Ltd.	112—116	..	..
188,120	,,	Dec. 20	7½	8	Plym'th & Ston'house 5 p.c.	108—111	..	..
414,500	,,	Aug. 30	7½	7½	Portsm'th Con. Stk. 4p.c. Std.	109—112	..	..
326,782	,,	,,	5	5	Do. 5 p.c. max.	80—83	+1	81
2,334,464	1	—	—	—	Primitiva Ord.	26/—28/-	+-/6	26/3—27/6
244,500	100	Dec. 3	4	4	Do. 4 p.c. Red. Deb.	91—94	..	..
695,000	Stk.	July 26	4	4	Do. 4 p.c. Red. Deb. 1911	79—81	..	79½
416,345	,,	Dec. 20	4	4	Do. 4 p.c. Cons. Deb.	78—80	..	..
150,000	10	Sept. 27	6	6	San Paulo 8 p.c. Pref.	8½—8¾	..	..
1,736,968	Stk	Aug. 30	—	—	Sheffield Cons.	104—106e	..	..
95,000	,,	Jan. 10	—	—	Do. 4 p.c. Deb.	73—75e*	−2	..
90,000	10	June 14	:3	†4	South African	4—6	..	..
6,609,895	Stk.	July 26	7½	5	South Met. Ord.	106½—108½	..	106½—108
500,000	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	110—113	..	..
1,895,445	,,	Jan. 10	3	3	Do. 3 p.c. Deb.	59—61*	..	61
784,000	,,	Sept. 13	6½	6½	Do. 6½ p.c. Red. Db.	101—103	..	102
91,500	,,	Aug. 16	8½	8½	South Shields Con.	109—110d	..	..
1,243,795	,,	July 26	6½	6½	South Suburban Ord. 5 p.c.	109—112	..	..
868,837	,,	Dec. 20	5	5	Do. 5 p.c. Deb.	97 100	..	99
647,740	,,	Aug. 30	5	5	South'mpton Ord. 5 p.c. max.	77—79	..	78½—79
121,275	,,	Dec. 20	4	4	Do. 4 p.c. Deb.	72—76	..	..
250,000	,,	Aug. 30	7	7	Swansea 7 p.c. Red. Pref.	101—103	..	..
200,000	,,	Dec. 20	6½	6½	Do. 6½ p.c. Red. Deb.	99—101	..	..
120,000	,,	July 26	7½	8	Tottenham District A 5 p.c.	..	..	..
882,275	,,	,,	6½	6½	Do. B 5½ p.c.	101—104	..	..
150,000	,,	,,	5½	5½	Do. 5½ p.c. Pref.	96—99	..	..
181,255	,,	Dec. 6	4	4	Do. 4 p.c. Deb.	75—78	..	..
289,094	,,	Aug. 30	6⅛	6⅛	Uxbridge, Maidenhead, & Wycombe 5 p.c.	93—98	..	96—97
83,880	,,	,,	5	5	Do. 5 p.c. pref.	87—92	..	..
80,000	,,	July 12	8½	8½	Wandsworth, Wimbledon, and Epsom— Wandsworth A 5 p.c.	120—125	..	..
235,686	,,	,,	7	7½	Do. B 5¼ p.c.	113—118	..	..
432,585	,,	,,	6/19/0	6½	Do. C and New	99—104	..	..
325,000	,,	,,	6½	6½	Do. Wimbledon 5 p.c.	107—112	..	..
95,000	,,	,,	7½	7½	Do. Epsom 5 p.c.	117—122	..	..
200,000	,,	,,	5	5	Do. 5 p.c. Pref.	88—91	..	..
88,416	,,	Dec. 20	3	3	Do. 3 p.c. Deb.	56—59	..	..
284,743	,,	,,	4	4	Do. 4 p.c. Deb.	75—78	..	..
202,500	,,	,,	5	5	Do. 5 p.c. Deb.	96—98	..	..

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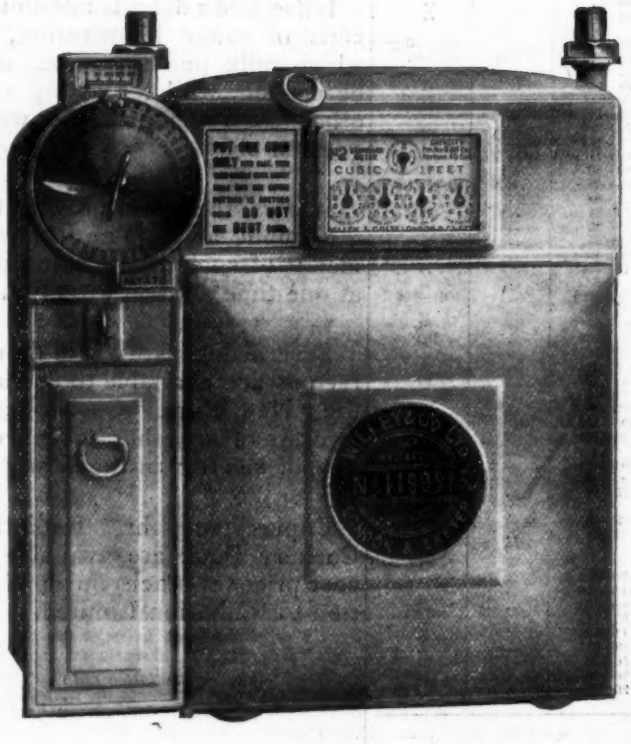

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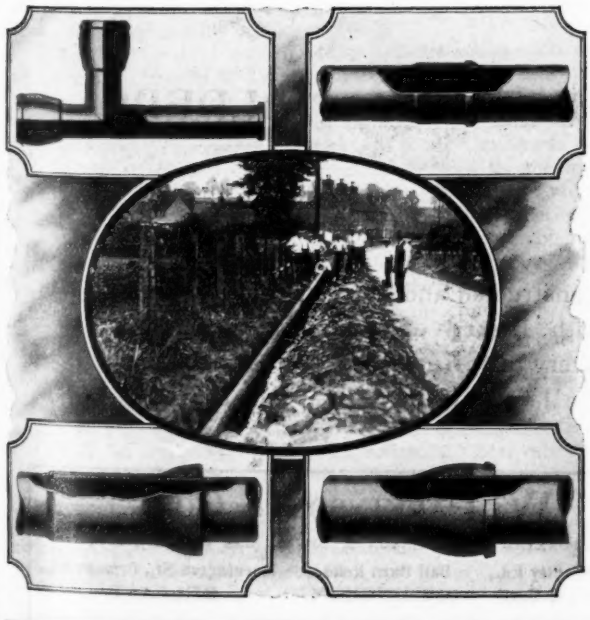

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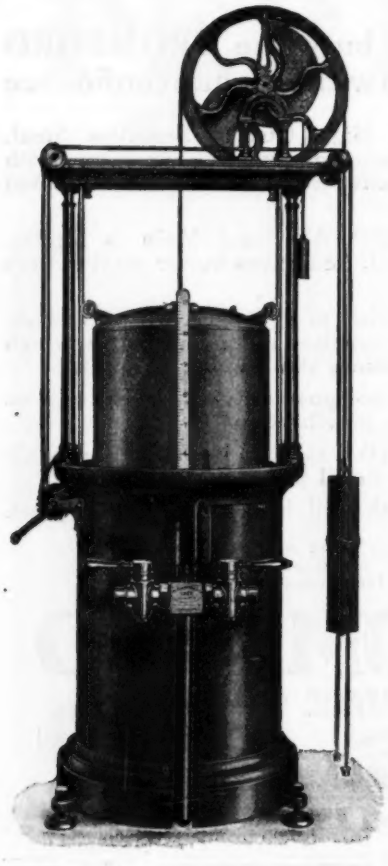

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